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STUDY OF POTENTIAL FOR MOTOR VEHICLE FUEL ECONOMY IMPROVEMENT

POLICY ASSESSMENT PANEL REPORT

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16. Abstract

This Policy Assessment Panel Report is Report Number One (1) of seven (7) panel reports prepared by special panels of a task force established under joint chairmanship of the U.S. Dept. of Transportation and the U.S. Environmental Protection Agency to conduct a study of the practicability of a 20% fuel economy improvement for new motor vehicles in the 1980 time frame. Materials developed by the various study panels were used in preparing the Report to the Congress entitled "Potential for Motor Vehicle Fuel Economy Improvement" dated 24 October 1974 (second printing 18 November 1974).

This panel report selects eight specific fuel economy improvement strategies which fall into the broad catagories of new car fuel economy labeling, government established and enforced fuel economy standards and vehicle taxation to dissuade purchases of new automobiles with poor fuel economy. The strategies are evaluated on the basis of their impact on consumers, producers and government administration. The report concludes that none of the strategies is clearly preferable over all the others. Each has its strength and weakness.

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PREFACE

This Policy Assessment Panel Report is No. 1 of a group of seven (7) prepared by special panels of the Task Force established under the joint chairmanship of DOT and EPA to conduct a study of the practicability of a fuel economy improvement standard of 20% for new motor vehicles produced in the 1980 time frame. Each panel addressed a major impact area and drew on a variety of sources in preparing its report, including previous DOT and EPA research, and industry and public comments.

Materials developed by the various study panels were used in preparing the Report to Congress entitled "Potential for Motor Vehicle Fuel Economy Improvement", dated 24 October 1974 (second printing, 18 November 1974). Assumptions and conclusions expressed in the panel reports, however, are those of the respective panels and do not necessarily reflect official positions or policies of the U.S. Department of Transportation, the U.S. Environmental Protection Agency, or the study Task Force.

The complete Panel Reports set consists of the following:

Report No. 1: Policy Assessment Panel Report
Report No. 2: Safety Implications Panel Report
Report No. 3: Air Quality and Emissions Panel Report
Report No. 4: Technology Panel Report
Report No. 5: Economics Panel Report
Report No. 6: Fuel Economy Test Procedures Panel Report
Report No. 7: Truck and Bus Panel Report

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1. BACKGROUND

1.1 PURPOSE

Section 10 of the Energy Supply and Environmental Coordination Act of 1974 (PL 93-319) hereinafter referred to as the Act, directs the Administrator of the Environmental Protection Agency (EPA) and the Secretary of the Department of Transportation (DOT) to conduct jointly a study and report on the practicability of a fuel economy improvement standard of 20% for new motor vehicles in the 1980 time frame.

In the execution of that study, seven panels were organized within the two agencies, and assigned specific areas of investigation upon which to report. This document is the "Policy Assessment Panel Report". The findings of the seven panels were summarized and submitted to Congress on October 24, 1974, under the title "Potential For Motor Vehicle Fuel Economy Improvement - Report to the Congress".

The work of the Policy Assessment Panel focused upon the merits and deficiencies of various implementation strategies and enforcement mechanisms by which fuel economy improvements can be elicited. It draws heavily from the findings of the other panels and, in some cases, the reader will be refered to the other panel reports for more detailed explanations. Selected charts and tables have been reproduced here, however, to make this report as much of a self-contained document as is possible.

The exposition begins with a minimal coverage of definitions and technological background to prepare the uninitiated reader sufficiently to understand the analysis. The nine implementation strategies that were selected for examination are then described at a general level. The evaluation criteria by which the assessment of the strategies was done are presented, followed by the results of that assessment and the conclusions which can be drawn from it. The discussion then shifts to a review of the administrative problems which would be inherent in the implementation of any strategy, such as test and certification, labeling and enforcement

remedies. The main body of the report then concludes with a brief summary of the findings. For those readers with a higher level of interest, an analysis of each strategy under each evaluation criterion, and the detailed comparison of strategies is provided as Appendix material.

1.2 BASE YEAR

There were particular difficulties with the choice of a base year. The first was the fact that a 13.5% improvement in fuel efficiency was made in 1975 over 1974.[1] Thus, achieving a 20% improvement by 1980 over 1974 had in large part already been accomplished. Second, the 1974 fuel economy (14 mpg) was near the modern low for new cars. The 1970 fuel economy of the fleet, for example, was 15.4 mpg or 10% better than that of 1974. Third, one could argue that some year preceding the imposition of emissions, safety, and damageability standards should have been selected as the one to use as the base of comparison.

The year 1974 was chosen because it was the year of the date of the Act and the last year for which production data were available.

1.3 ARTICULATION OF STANDARDS

The Act to which this report responds defines the "Fuel Economy Improvement Standard" in terms of a required"... percentage increase in the number of miles of transportation provided by a manufacturer's entire annual production of new motor vehicles per unit of fuel consumed..." The fuel economy standards were thus intended to be articulated in terms of improvement objectives, the achievement of which was measured by the *production weighted*

[1] EPA-FEA Announcement, September 20, 1974. This 13.5% fuel economy improvement assumes the same production mix in 1975 as in 1974.

averages of the fleet produced by each manufacturer.[1] During the course of the study, it became apparent that improvement objectives stated as fuel economy performance standards for individual classes of automobiles could also improve the production weighted average fuel economy with great effectiveness. Thus there is a second mode, *class standards*, by which fuel economy standards can be articulated. As will be seen below, the manufacturers will respond differently, depending upon the mode in which improvement standards are expressed.

The standard must also articulate the level of improvement sought. The Act directed that the study address the question of whether or not an average fuel economy improvement of 20% or better can readily be achieved by 1980. The results indicated that significantly higher improvements were possible. President Ford, in his October 8, 1974, message to the Congress, announced a program to achieve an improvement of 40%, which is now being implemented by the Secretary of Transportation. During November and December 1974 the Senate Commerce Committee conducted hearings on a 50% improvement in auto fuel economy.

In addition to the forms of the standard, and the level of improvement sought, variation is also possible as to the units by which improvement in performance is measured. Most discussions at the public policy level have been in terms of increased miles per gallon. However, for reasons cited in Section 2.3 and Appendix A, decreased gallons per mile may be the preferred unit of expression. Other surrogates for fuel economy, such as vehicle weight and horsepower have also been considered.

[1] If a manufacturer produces 100,000 units of Model A, and 500,000 units of Model B, and it is assumed that all vehicles will be expected to travel 100,000 miles, then it produces 100 billion miles of Model A transportation and 500 billion miles of Model B transportation for a total of 600 billion miles of transportation. In terms of fuel economy performance for its entire annual fleet, it may be seen that overall performance would be the performance of A weighted by the number of units of A produced plus the performance of B weighted by the number of B units produced. The averaging of rates requires use of the Harmonic Mean.

1.4 MEASUREMENT

In order for the performance of the various motor vehicles to be compared and evaluated, it will be necessary to standardize the means by which fuel consumption is measured. The difficulties of this lie with the fact that many factors influence fuel economy. Generally, these can be grouped into three categories: (1) Driving variables: including the route over which the driving takes place, the ambient and road conditions, trip conditions such as trip length, cold or hot start, etc.; (2) Vehicle variables; such as basic configuration (engine, weight, drive train, body style, tires), break-in mileage and state of tune; (3) Driver habits: such as rate of acceleration from a stop and ability to maintain a constant speed while cruising.

A viable fuel economy test procedure must establish a unique mpg value for each specific vehicle configuration, that takes account of the above variables, is representative of typical travel by an average driver, is consistent, and is precise. The Fuel Economy Test Procedures Panel Report, and Section 3.2 of the Report to the Congress provide extensive detail on how this can be done, and in particular the feasibility of using the chassis dynamometer in this role.

The problem of achieving one value representative of different kinds of travel has been resolved for the present by using a 55% weighting of the EPA 1975 Federal Test Procedure (city) and a 45% weighting of the EPA Highway Driving Cycles (highway) The mpg figures which appear in this report will be composit numbers of this type.

1.5 METHODS OF ACHIEVING THE STANDARD

Fuel economy improvements may be obtained in the 1980-1985 time frame by two methods. The first is technological improvements in the engine and drive train to increase efficiency and in the tires and body structures to reduce weight and drag. Included in this category is an engine size reduction for the larger cars. The second is a shift to a larger proportion of small cars in the

fleet. The improvement potential of each of these methods, placed in the context of present and past performance, may be seen in Figure 1.

1.5.1 Technological Options

The various configurations of systems by which fuel economy may be improved are shown in Table 1. These systems are described in more detail in the Technology Panel Report and Section 3.1 of the Report to the Congress. It may be seen that the fuel efficiency of large cars may be increased by as much as 62%, to 17.3 mpg; medium size cars may be increased by as much as 51%, to 19.8 mpg; and small cars may be increased by as much as 29%, to 28.8 mpg. The aggregate potential improvement by 1980 can be seen in line 3 of Figure 1.

1.5.2 Shift in Production Mix

Fleetwide improvements can also be accomplished by changing the fleet mix to more small cars. The historical trend in the percentages of each class of vehicle is shown in Figure 2. The aggregate potential for improvement by 1980 through shift mix, exclusive of technological upgrading can be seen in line 1 of Figure 1. The potential for improvement combining technological upgrading and shift mix can be seen in line 4.

1.6 SAFETY

Safety and fuel economy are related through a vehicle's weight and body structure. Today, a larger car with more crush space and heavier structure provides better protection but poorer fuel economy than the small car. Of equal importance to the crashworthiness of cars are the availability and usage rate of effective passenger restraint systems. Even in today's fleet, where the probability of being involved in an accident is relatively independent of car size, the belted occupant of a small car has approximately the same protection as the unbelted occupant of a large

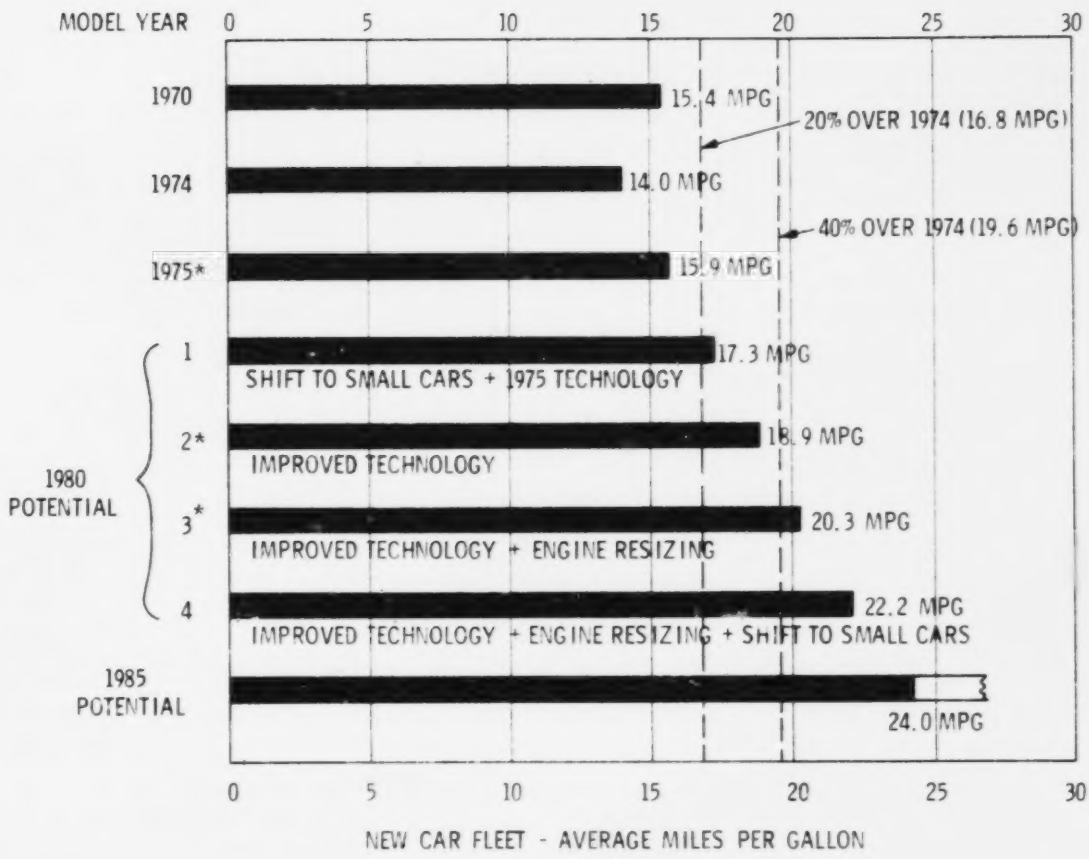


Figure 1 Potential for Automobile Fuel Economy Improvement

TABLE 1 SUMMARY OF SYNTHESIZED VEHICLE FUEL ECONOMY IMPROVEMENT
(1980 VEHICLES)

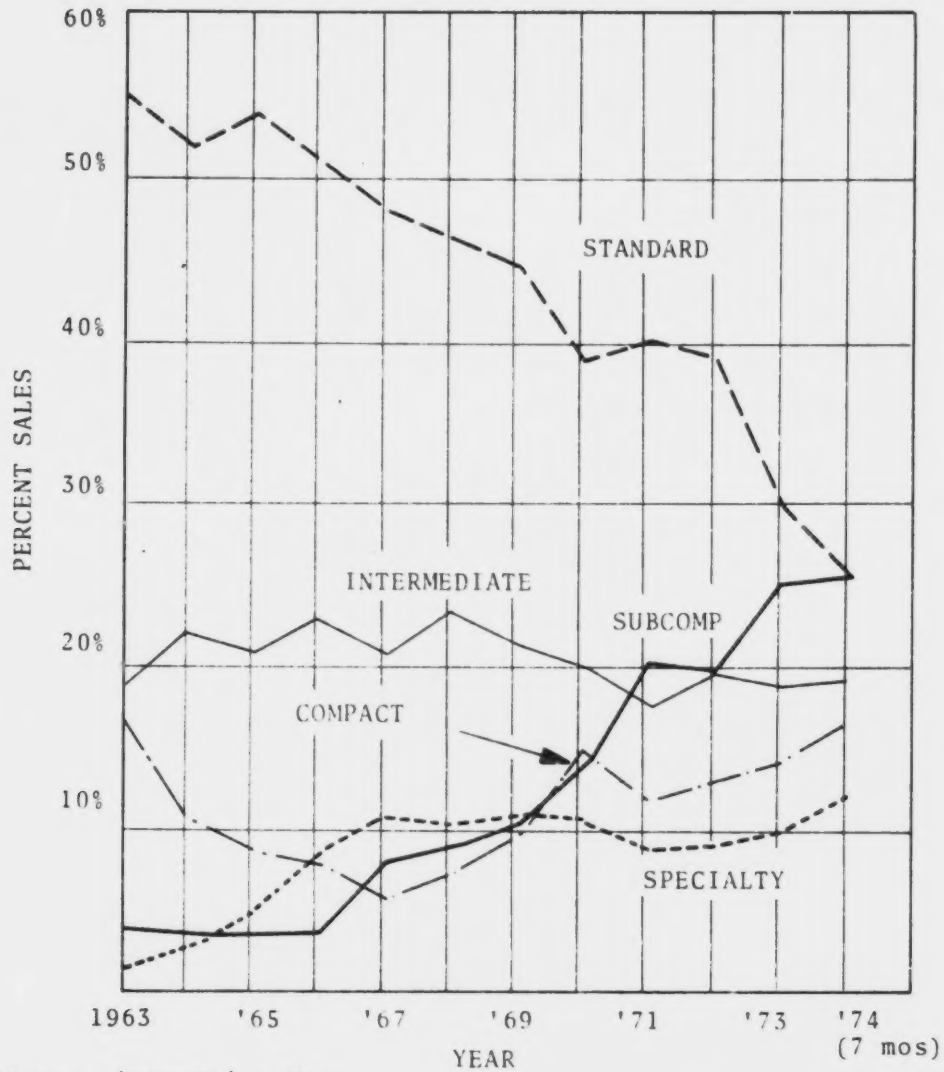
System*	Large Size		Mid-Size		Small Size	
	FE(%)	FE(mpg)	FE(%)	FE(mpg)	FE(%)	FE(mpg)
Ref. EPA Composite 1974 Vehicle Fuel Economy	0	10.7	0	13.1	0	22.3
1. Improved Engine	+25	13.4	+20.0	15.7	+15.0	25.6
2. System 1 + auto.trans. w/4 spd. + lock-up	+33.7	14.3	+28.7	16.9	+23.7	27.6
3. System 2 + radial tires + wt.red. + aero drag red. + acces. improvement.	+47.1	15.7	+41.1	18.5	+29.1	28.8
4. System 3 with engine resized.	+62.1	17.3	+51.1	19.8	+29.1**	28.8**

*See discussion for explanation of terms.

**System 4 identical to system 3, engine not resized.

NOTES:

1. Fuel economy is computed from EPA composite cycle.
2. Implementation of fuel economy improvements shown in this Table may be in a different order.



Source: Automotive News

Figure 2 Passenger Car Sales by Market Class (Including Imports)

car. Recognizing that present national policy is to reduce the serious injury and death rate on the highways, safety standards which would improve the crashworthiness and effectiveness of passenger restraint systems, especially for small cars, are necessary. If fuel economy improvements are achieved by a shift to a higher percentage of small cars in the fleet without concurrently upgrading their occupant protection capability, it is probable that the serious injury and death rate would rise. Detailed discussions of this problem will be found in the Safety Implications Panel Report and in Section 3.5 of the Report to the Congress.

1.7 ADMINISTRATIVE CONSIDERATIONS

The Act specifically raises the matters of test procedures required to determine compliance, and various means of enforcement. No mandated standard, regardless of which form is eventually adopted, can be implemented in the absence of the administrative operations by which Fuel economy measurement, labeling and enforcement can be performed. The problem of measurement was described in Section 1.4 and the issue of labeling will be found in Section 2.2. Section 4 is devoted to problems of enforcement.

1.8 CONDUCT OF THE ANALYSIS

The analysis began with a review of the various policy options or implementation strategies which have been evaluated in other available documents and agency papers which pertained to fuel conservation measures. These are included in the References (R-1). These "implementation strategies" were listed and culled for applicability for this particular study, along with a list of dimensions upon which these strategies had been evaluated. From this it became apparent that a comparison of the merits and deficiencies of the various strategies could not be accomplished using dimensions which reflect only static conditions. Rather, the response to the imposition of a standard must be thought through in terms of its dynamics: how producers would accommodate the standard, how consumers would react, and what the administering agency must do to enforce the

standard in the face of various forms of producer accommodation and consumer reaction. The original list of over 20 dimensions, some quantitative and some qualitative, was eventually reduced to 10 evaluation criteria. All of these were qualitative and reflected the dynamics underlying the results of the various implementation strategies. These are detailed in Section 3.

2. IMPLEMENTATION STRATEGIES

2.1 OVERVIEW

Government programs to encourage an improvement in auto fuel economy may be viewed as operating on either the demand side or the supply side of the market for new automobiles. Those applied to the demand side would encourage the consumer's preference for vehicles with better fuel economy, indirectly inducing manufacturers to produce better performing vehicles to satisfy that need. Those applied to the supply side would cause manufacturers to employ technological options that are more efficient, such as those described in Table 1. Action directed to the demand side of the market is exemplified by a government program of improving consumer information so that more informed choices can be made. Action directed to the supply side of the market would be a voluntary program of technological improvement, or the establishment of regulatory standards for the manufacture of new automobiles. Another kind of program, that of imposing taxes which favor more efficient autos, can be fashioned to act on either the demand or supply side.

Any discussion of means by which to elicit improvements in auto fuel economy should begin with one cautionary note: It is that gains in auto fuel economy expressed as a percentage improvement in mpg, whether achieved by market forces or use of a Federal standard, may not be translated into an equivalent percentage of real savings in national fuel consumption. This is because some of the saving would be offset by an increase in vehicle miles traveled brought about by lower costs of operation, and by increased sales of the larger (although improved) models. There are other possible measures which circumvent this problem and still would achieve the larger goal of reduced gasoline consumption at the national level (e.g., rationing or restricted oil imports). Such considerations, however, are beyond the question of the practicability of the proposed standard as posed by the Congress.

The implementation strategies which were considered fall into four categories: labeling, production weighted standards, class standards, and vehicle fuel efficiency taxes. Some of these have been evaluated by others before, and some originate with this study. They are listed as follows:

Labeling Alternatives

(A) Voluntary Fuel Economy Labeling

(B) Mandatory Fuel Economy Labeling

Production Weighted Average Standards

(C) A Common Standard (e.g., 16.8 mpg. for all mfrs.)

(D) A Uniform Percentage Improvement (e.g., 20% improvement for all)

(E) A Variable Improvement Standard (unique for each mfr.)

Class Standards

(F) Uniform Improvement for each Class (e.g., 2.8 mpg for all classes)

(G) Variable Improvement for Each Class (unique for each class)

Vehicle Fuel Efficiency Taxes

(H) Excise Tax

(I) Annual Fuel Efficiency Tax

The letter designations given in the list will be used to identify these alternatives throughout the remainder of the text.

It may be seen that some strategies are included which are not standards, in the sense given in Section 1.3. This was done because it was felt that it is not possible to truly answer the question of practicability of standards without some comparison of alternative means of implementation. The fact that alternatives were selected for consideration does not in any way imply advocacy.

The strategies selected were limited to those which are directly applicable to new car sales. These afford a very broad range for comparison, even at the most general level. For example, the labeling strategies depend solely upon heightened consumer awareness of fuel economy, and the latent market reaction this improved information is expected to evoke. Their principal merits

are that they afford maximum producer flexibility and maintain a full range of consumer choice with little government intervention in the free market. The major drawback is that they are limited in their ability to assure attainment of the goal.

The standards expressed as production weighted averages represent more direct forms of government intervention, but still allow the manufacturer a certain freedom of choice: he can exploit improved technology, he can work to change sales mix to smaller cars, or he can combine both to achieve the overall fleet performance objective. They also allow continued entry into the fleet of some very inefficient new cars.

In contrast, standards articulated as improved fuel efficiency for each class of vehicle stimulate changes only in the technological realm. Their use assures improvement in fuel economy performance for inefficient vehicles of all classes. They are more precisely described, better understood by the manufacturers, and there is less uncertainty about what will result. A manufacturer may produce as many of one class of vehicles as desired so long as each vehicle complies with the standard for its class.

The remaining two alternatives depend upon taxes that are inversely related to the fuel efficiency of the vehicles, i.e., the better the mpg, the lower the tax. One would be applied at the time of sale, the other on an annual basis. Neither would guarantee the achievement of the overall improvement goal since the manufacturer could continue to market less efficient vehicles and let the consumers pay the taxes. It would, as a minimum however, increase perceived costs in direct relationship to fuel economy performance It thus represents an indirect incentive to produce more efficient vehicles.

2.2 FUEL ECONOMY LABELING[1]

Manufacturers would be required to provide fuel efficiency data along with other information currently required by federal law. In addition, comprehensive labels detailing economy would be placed on new vehicles for sale, indicating certified fuel economy test results. Manufacturers would also be required to use official test results in all advertising of new models. An annual compilation of the fuel economy results of all cars tested would be published as a comparative guide for consumers. Variations under this policy would be:

Voluntary Labeling (Alternative A)

Current EPA and FEA programs - Compliance discretionary

Mandatory Ladeling (Alternative B)

All manufacturers and dealers must comply

Under voluntary labeling, a publicity campaign would be used to exert pressure on the manufacturers to participate as well as to educate the consumers about fuel economy. A program of labeling new cars with mpg performance is now being tried on a voluntary basis using EPA mileage test data. Although still in its early stages, the labels are presently being torn off by some dealers; and even when left on, are not as informative as they might be.

[1]Discussions are presently under way with the manufacturers on how to achieve, on a voluntary basis, the 40% improvement in the fuel economy announced by President Ford in his October 8 message to the Congress. This action has mooted somewhat the original description of this option and the form in which it appeared in the Report to the Congress. Originally defined as a program of voluntary fuel economy goals with voluntary or mandatory labeling, it has been modified herein to consider only its labeling facets.

Whether voluntary or mandatory, the responsible agency would become heavily involved in developing advanced labeling formats, and administering and certifying test results. In addition, an enforcement scheme would need to be developed in order to ensure that manufacturers were labeling as required, and with accurate information. The implementation of an enforcement program, however, would not require significant agency resources or any extended period of time.

The idealized, most informative labeling scheme would be comparable to the present price sticker. It would display the basic fuel economy of the model, and then list the degradation or improvement associated with each accessory, in much the same way that the present price sticker shows base price and then the added costs for added features on that particular vehicle. If possible, this information should be augmented with readily available data in the showroom on the fuel economy payoff associated with each feature, ranked in the order of increasing fuel economy per increased cost (e.g., change in mpg per dollar investment). Alternatively, the change in mpg per dollar investment figure could be converted to its equivalent in change in operating costs per dollar investment. Under that scheme even the relatively unsophisticated buyers could equate all options to fuel economy.

The suggestion that such data be made available assumes that the variations in mpg due to the factors cited in Section 1.4 (e.g., city vs. highway and different driving habits) could be normalized to a single representative mpg figure. The feasibility of this notion is as yet untested.

2.3 PRODUCTION WEIGHTED AVERAGE STANDARDS

2.3.1 General

Regulation by standard setting is the most direct means by which government can affect the practices of private industry. Under this category of alternatives, the responsible agency would establish a standard articulated as the production weighted

average fuel economy of each manufacturer's entire fleet of new vehicles.

The complexities of determining this standard, coupled with the necessity of establishing viable enforcement mechanisms which accurately weigh and tabulate production averages with sufficient precision to enforce it, present difficult although not unsurmountable problems. Achievements of the goal for the fleet is continuously subject to unanticipated shifts in market preferences which may well be beyond the manufacturer's control. Further, the final results of such control efforts will not be known until the end of the model year, a problem which may be mitigated somewhat but not entirely by exercising controls at the production planning level.

Consideration of the production weighted average standards thus assumes that manufacturers would be able to predict with reasonable accuracy their production mix over the course of each year and apply whatever combination of sales and technology is required to meet the standard. Each would tailor its production as it sees fit, depending on the fuel economy of its own specific mix of models, their profit margins, and the capacity of the plants which produce them. Imposition of this kind of standard tends to lock manufacturers into their present markets: while movement would be possible into the market for smaller vehicles without harm to their production weighted averages, it would be difficult to move into the market for larger vehicles without producing models sufficiently improved technologically that they would balance out the foregone better performing smaller ones. Finally, it would be noted that the manufacturer's ability to alter sales mix through raising profit margins on the large, inefficient cars, and exhorting buyers to select the small, more efficient ones is largely an untested and unproven concept.

The flexibility with which the manufacturers can respond to such standards depends in part upon the level of improvement chosen as an objective. They would be likely to accommodate a 20%

improvement goal (16.8 mpg) primarily through the upgrading of technology, rather than attempting to change production mix. At a 30% improvement level, however (18.2 mpg), it is expected that they would have to resort partially to both measures, but they would still have some flexibility as to which they pursued. This may be seen in Figure 1, lines 1 and 2, which indicate that is is possible to achieve 18.2 mpg using either option. As may be expected, at the 40% level, (19.6 mpg) manufacturers will have to exercise most of their available options, leaving little choice about which to reject.

The following sections briefly review three variations under this category of standard:

(C) a common standard (e.g., 16.8 mpg for all manufacturers),

(D) a standard stated as a uniform percent improvement (e.g., 20% improvement for each manufacturer),

(E) a variable standard based on the costs to improve fuel efficiency for each manufacturer.

2.3.2 *The Common Standard* (Alternative C)

All manufacturers would be required to meet the same specific fuel economy objective in absolute terms regardless of their current production mix. A 20% improvement over the 1974 national average would result in a 16.8 mpg target. Under this standard, General Motors whose fleet weighted average was only 12.2 mpg in 1974, would have to attain the same average in 1980 as American Motors, whose average was 16.8 mpg.

This alternative places those who have been working to improve fuel efficiency in a better position to meet the standard then those who have not. This may be demonstrated in the extreme if the 40% improvement standard were to be envisioned, and all manufacturers had to achieve a sales weighted average of 19.6 mpg.

Using EPA fuel economy data as modified in columns D in Table 2[1], GM would have to improve their fleet from their 1974 level of 12.2 mpg by 7.4 mpg or 61%. Ford would have to increase its fuel economy by 5.2 mpg or 36%, Chrysler by 5.8 mpg or 42% and AMC by 2.8 mpg or 17% over 1974. It may also be of interest to view these differing spans of improvement from the mpg figures forecast for 1975, which appear in Column E. For that case the comparable figures are: GM would have to increase its fleet fuel economy by 3.9 mpg or 25%. Ford would have to increase its fuel economy by 6.3 mpg or 47%, Chrysler would have to increase its fuel economy by 3.8 mpg or 24%, and AMC would not have to increase its fuel economy at all.

The question may also arise as to what the U.S. manufacturers would have to do to meet the objective in comparison with foreign manufacturers. On the basis of the 1975 mpg forecasts, VW, Toyota, Nissan, Audi, Peuegot and Saab are already over the 40% improvement standard of 19.6 mpg.

It may be seen that this option appears to place differing burdens upon the various manufacturers depending upon where they happen to be in the fuel economy competition.

It may be expected that first costs of large cars (27% of the 1974 fleet) would increase a great deal, and medium size cars somewhat (45% of the 1974 fleet). The need to maintain the competitive attractiveness of the smaller cars to encourage mix shifts would make their comparative price even less expensive. Concommitantly, there would be a tendency to shift present profit margins to bigger models, which would not only dissuade their volume of sales, but also make the sales of larger cars that are possible more lucrative.

[1]As noted in Section 1.5 these are composit numbers representing a weighting of 55% City, 45% Highway driving. Columns D and E are approximated composits attained by multiplying the city value by 1.16. The 1975 figures assume a fleet mix similar to 1974 for each manufacturer, a presumption which appears less and less valid as the 1975 model year sales slump continues.

TABLE 2 COMPARISON OF 1974/1975 FUEL ECONOMIES BY MANUFACTURER AND TOTAL FLEET
(SALES WEIGHTED AVERAGES)

(A) Manufacturer	(B) 1974 City Fuel Economy MPG	(C) 1975 City Fuel Economy* MPG	(D) Approx. Composite 1974 Fuel Economy** (B x 1.16)	(E) Approx. Composite 1975 Fuel Economy** (C x 1.16)
General Motors	10.5	13.5	12.18	15.66
Ford	12.4	11.5	14.38	13.34
Chrysler	11.9	13.6	13.80	15.78
AMC	14.5	16.9	16.82	19.60
VW	22.2	22.9	25.75	26.56
Toyota	19.2	18.8	22.27	21.81
Nissan	20.7	21.4	24.01	24.82
Volvo	16.6	15.6	19.26	18.10
Audi	19.1	20.3	22.16	23.55
Peuegot	17.5	19.1	20.30	22.16
Saab	19.2	21.4	22.27	24.82
Mercedes	11.4	12.8	13.22	14.85
BMW	17.5	14.8	20.30	17.17
All Combined	12.1	13.6	14.04	15.78

*Assumes sales weight in 1975 woudl be same as that of 1974. Source of Columns A, B, and C is EPA report of 9-19-74.

**The composite numbers representing 55% city and 45% Highway are approximated by taking the City Figures times a factor of 1.16.

Regarding safety, under this alternative there is pressure to eliminate the very heavy models, and more emphasis on promoting the smaller models, so the population at risk will be in slightly lighter vehicles.

2.3.3 *The Uniform Percentage Improvement* (Alternative D)

All manufacturers wou'l improve the production weighted average fuel economy of their current fleet by a specific percentage (e.g., 20%,) regardless of their current production weighted average.

This alternative is patently unfair to those manufacturers who are already producing in the more efficient range because their past progress in this area now becomes a penalty in the form of a higher absolute requirement. The inequities of this may be demonstrated by again resorting to our earlier example. Using a 40% standard applied to 1974 performance, AMC (having already moved toward better fuel economy) with 16.8 mpg would have to achieve an absolute improvement of 6.7 mpg; in contrast, GM starting from 12.2 mpg, would have to achieve only a 4.9 mpg improvement.

Because the small cars with good economy models suffer a disproportionate increase in improvement objective, which must be met through technological upgrading, the relative price increases of small models will be higher than under any other alternative. From the safety viewpoint because of the undue pressure to improve the smaller models the light cars will be even lighter. An even larger proportion of the population will be in lighter cars and their occupants will be even less safe.

2.3.4 *Variable Improvement Standard* (Alternative E)

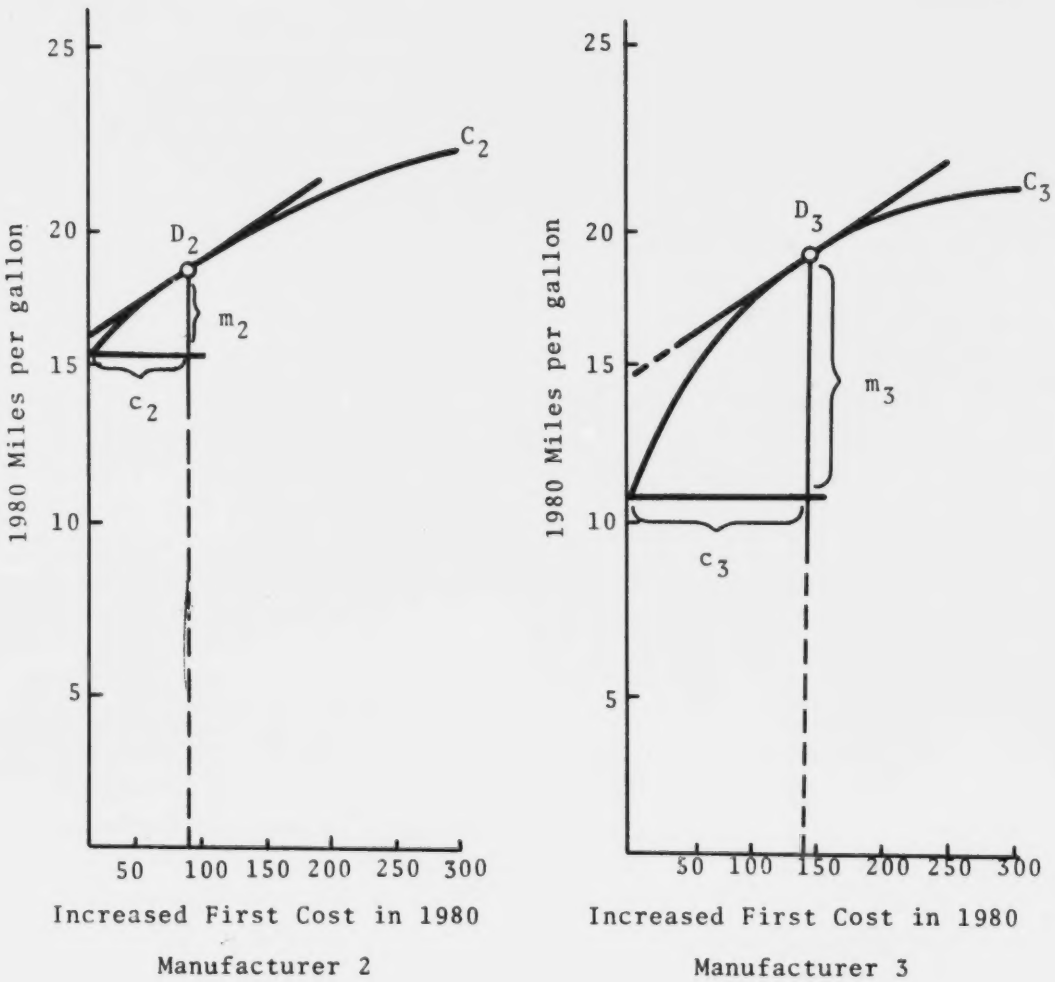
The mandated national increase in mpg would be translated into an improvement objective that varies for each manufacturer. This would be determined for each based upon the marginal cost to increase the fuel efficiency of its fleet, but which, in combination, minimizes the aggregate cost increase to buyers of new 1980 automobiles. Thus, by taking the objective (such as the 20%

improvement called for in the Act or the 40% improvement called for by President Ford) as an overall national aggregate to be achieved, the contributions to that objective can be optimally allocated using well known and accepted procedures. This is predicated, however, on the assumptions that the cost functions for each manufacturer can be estimated with sufficient precision to make the procedure valid, and that automobile prices have a direct and consistent relationship to costs for all manufacturers.

This may be better explained by reference to Figure 3. Curves are depicted for two hypothetical manufacturers labeled 2 and 3. They plot for the production weighted average of each manufacturer, the increased first cost of that manufacturer's new 1980 cars, vs. the increased mpg achieved by those new cars.[1] It may be seen that manufacturer 2 is producing a fleet with better fuel economy than manufacturer 3, and that in 1980, manufacturer 2 can produce a fleet with a weighted average mpg of 15.2 at no increase in first costs of his new cars, while manufacturer 3 can produce a fleet with a weighted average mpg of only 10.6 with no increase in first costs.

It may also be seen from the curves that manufacturer 3, having utilized very few of his technological options to improve fuel economy, can achieve substantial increases in mpg at little increase in first costs (i.e., the left part of the slope of the curve is steep). In contrast, manufacturer 2 has already utilized some of his technological options to achieve his superior fuel economy, and may be expected to achieve less of a fuel economy improvement per dollar of increase in first costs (i.e., his curve is flatter). It may further be seen from the slope of the curve that as manufacturer 3 begins to utilize his most economic options, his curve also begins to flatten and he will begin to also achieve less and less increase in fuel efficiency per dollar increase in first cost.

[1]Similar curves could be drawn for either individual car models, or for classes of car, and the same reasoning could be applied. For purposes here, it is simplest to treat the output of one manufacturer as an average of all his vehicles or all his classes.



m_i Represents the increase in miles travelled with one gallon of gas for 1980 cars of type i

c_i Represents the increase in unit cost to achieve m_i

C_i Represents the function which relates m_i to c_i

Figure 3 Cost Curves for Improved Mileage in Vehicles of Two Hypothetical Manufacturers

As shown in Appendix A, it is possible to derive mathematically that point for each manufacturer which when taken collectively with the others, will result in achieving a stipulated target improvement in mpg for the nation's 1980 fleet. Further, it is possible to do so in such a way that the total increase in costs for buyers of the 1980 fleet will be minimized. The ramifications of this are illustrated by further reference to Figure 3. It may be seen that under such an optimizing procedure, manufacturer 2 will be required to improve up to point D_2, raising the mpg of his fleet by m_2, and raising the first costs of his new cars by c_2. Manufacturer 3 will be required to improve up to point D_3, improving the mpg of his fleet by m_3 and raising the first costs of his new cars by c_3. The objectives are clearly not the same for each. For manufacturer 2 it would appear that his mileage would increase from 15.2 to 18.2 mpg, or 3 mpg, adding about $85 to first costs of his new cars. For manufacturer 3 it would appear that his mileage would increase from 10.6 to 18.5, or 7.9 mpg, adding about $140 to the first costs of his new cars.

As may be suspected from general economic theory, points D_2 and D_3, and those for any other manufacturer turn out to be the points where the slopes of the cost curves for each manufacturer are equal and the points where the marginal costs of improvement are equal. This is also proven in Appendix A. As a result, the cost of imposing a given aggregate mpg improvement as a national objective is distributed over all buyers of the new car fleet, and each would pay the same for the last marginal increment in fuel economy.

It is appropriate to note at this point that in regard to our broader goals, it is preferable to state the improvement objective to be optimized in terms of a reduction in gallons per mile (i.e., the gallons used by the fleet to drive a given number of miles) rather than an increase in miles per gallon. Under the latter scheme, an increase from 10 to 11 mpg is given equal weight with an increase from 20 to 21 mpg or even 30 to 31 mpg. If in reality the national objective is to save gasoline, the improvement from 10 to 11 mpg is much more significant than an increase from 20 to

21 mpg, if one assumes that owners of efficient vehicles use theirs in a comparable way with owners of inefficient ones (e.g., both drive about the same number of miles the first year of ownership). This is so because the owner of the 10 mpg vehicle would use twice as much gas to travel his intended miles as the owner of the 20 mpg vehicle.

Section F through I of Appendix A shows that if the improvement objective is in gpm, the optimization process will allocate more of the burden of upgrading to those vehicles which could be made to consume less gasoline to drive the same amount of miles rather than on the vehicles which can raise mpg the most for given cost increases.

There remains, of course, the question of whether or not the types of cost functions envisioned in the Figure can be derived for each manufacturer. The complexities are substantial, and there was inadequate opportunity to determine this in the period allowed by the Congress in which to execute this study.

2.4 CLASS STANDARDS

2.4.1 General

Class standards represent a different mode of standard setting by which to achieve regulation. Standards of this category are articulated as a minimum level of mpg performance which must be met for all vehicles within a given class. The responsible agency must determine the means of making the class distinctions as well as the appropriate performance level for each class. There are various approaches to classification including market class, weight, engine size and fuel economy. The more precise the class distinction, the easier the program would be to administer. There would be some problem with class distinctions currently in use because historically, they tend to shift. One way in which this might be avoided is to use a classification based on weight (i.e., 4100# class, 4300# class, 4500# class, etc.).

Standards of this category have the advantage of placing primary emphasis on technical improvements, which are better understood and more tractable than market forces. The improvement for each class would be stated as a minimum performance standard to be attained by every vehicle within that class. New models could not be introduced which did not meet their class standard. A slight disadvantage is the lack of certainty about achieving an overall national improvement in fleet mpg, because of the eventuality that sales of the less efficient (although improved) models would increase.

The viability of utilizing standards expressed in this mode may be seen from the curves of Figure 4. They show that comparable improvements in mpg can be realized for all classes without any reduction in weight. Between the curve labeled Potential 1980 New Cars and the one labeled 1974 New Cars an objective curve would be set that would result in the desired improvement over 1974.

This kind of standard provides incentive for fuel economy improvement for the whole range of vehicle types. Existing models which outperform the standard would remain unchanged, but it is assumed that technological improvements would be required for most models. An estimate of the extent to which higher mpg performance of the nations fleet can be realized through technological improvements is shown in Figure 1, line 2.

There is more producer flexibility under standards articulated as production weighted averages than under this category of standard. The first mode states the objective for each manufacturer in terms of one point (i.e., an mpg average) which it may meet in any way it is able. In contrast, class standards state the objective as a grid of points (i.e., weight vs. mpg) whose granularity can become quite fine or even result in a continuous curve. A different kind of flexibility prevails under class standards, however, in that producers are much freer to enter new markets, and can do so as long as they adhere to the standard for that class.

Class standards assure that the burden of improvement and their resultant costs are distributed more evenly over the entire

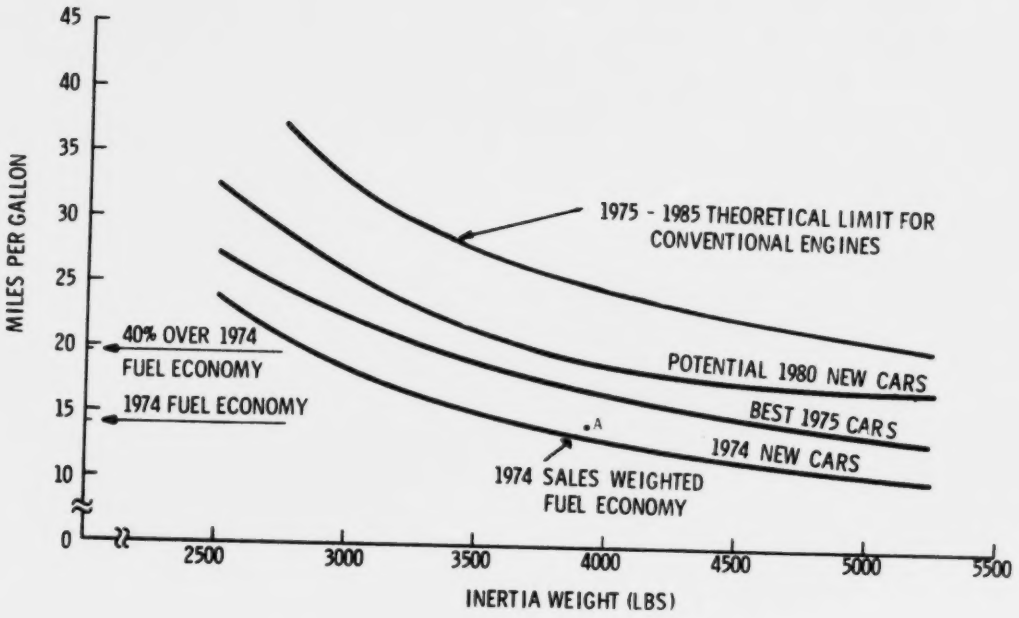


Figure 4 1975 - 1985 Technological Potential for Fuel Economy

line of models, from small to large, although probably not as equitably as would be possible under Alternative E, the variable production weighted standard.

If the classification scheme is by weight, it does not encourage the weight reduction that would decrease occupant safety. Under these alternatives, in fact, there would be a tendency for cars to become heavier as manufacturers redesign in the direction of standards with lower mpg values.

The determination and then enforcement of class standards would depend upon the process of a complex bureaucracy wrestling with a complex industry over a complex set of standards. Nevertheless, the standards would be stated in more precise fashion, would be better understood by all parties, and there would be no need to monitor production mix and constantly recompute averages. Either variation under this category of standards should thus be less expensive to administer than those articulated as production weighted averages.

2.4.2 *Uniform Fuel Economy Improvement* (Alternative F)

Based on the performance of the 1974 fleet, the desired gain in fuel economy would be translated into a uniform mpg improvement for all classes (i.e., an increase of 2.8 mpg across the whole spectrum of classes would achieve approximately a 20% improvement). This is represented by curve F of Figure 5. It may be seen that it is a uniform distance above the 1974 curve.

2.4.3 *Variable Fuel Economy Improvement* (Alternative G)

There is no overriding reason why the improvement has to be uniform for all classes, and it is quite feasible to consider how the burden may be allocated to optimize for other objectives, such as the minimization of cost to the buyers of the 1980 fleet, or the minimization of gallons used by the 1980 fleet, both of which were described under the discussion of Alternative E. The latter optimization process would result in the curve being tilted, such as that represented by curve G in Figure 5.

Other secondary objectives are also possible and should be considered. It may be seen that Alternative F is in fact a special case of the variable class standard in which the objective met is a uniform absolute mpg improvement for all classes.

2.5 VEHICLE TAXATION

2.5.1 General

Taxation strategies represent less direct means of inducing fuel economy. While not standards per se, and therefore not directly within the purview of the Act, representative forms of taxation were included in the analysis, to support deliberations that may arise as to the general practicability of standards vis a vis taxes on vehicles. Because the entire analysis is limited to implementation strategies that can be applied to new car sales, a variety of other forms of taxation, such as gasoline taxes and import taxes are excluded.

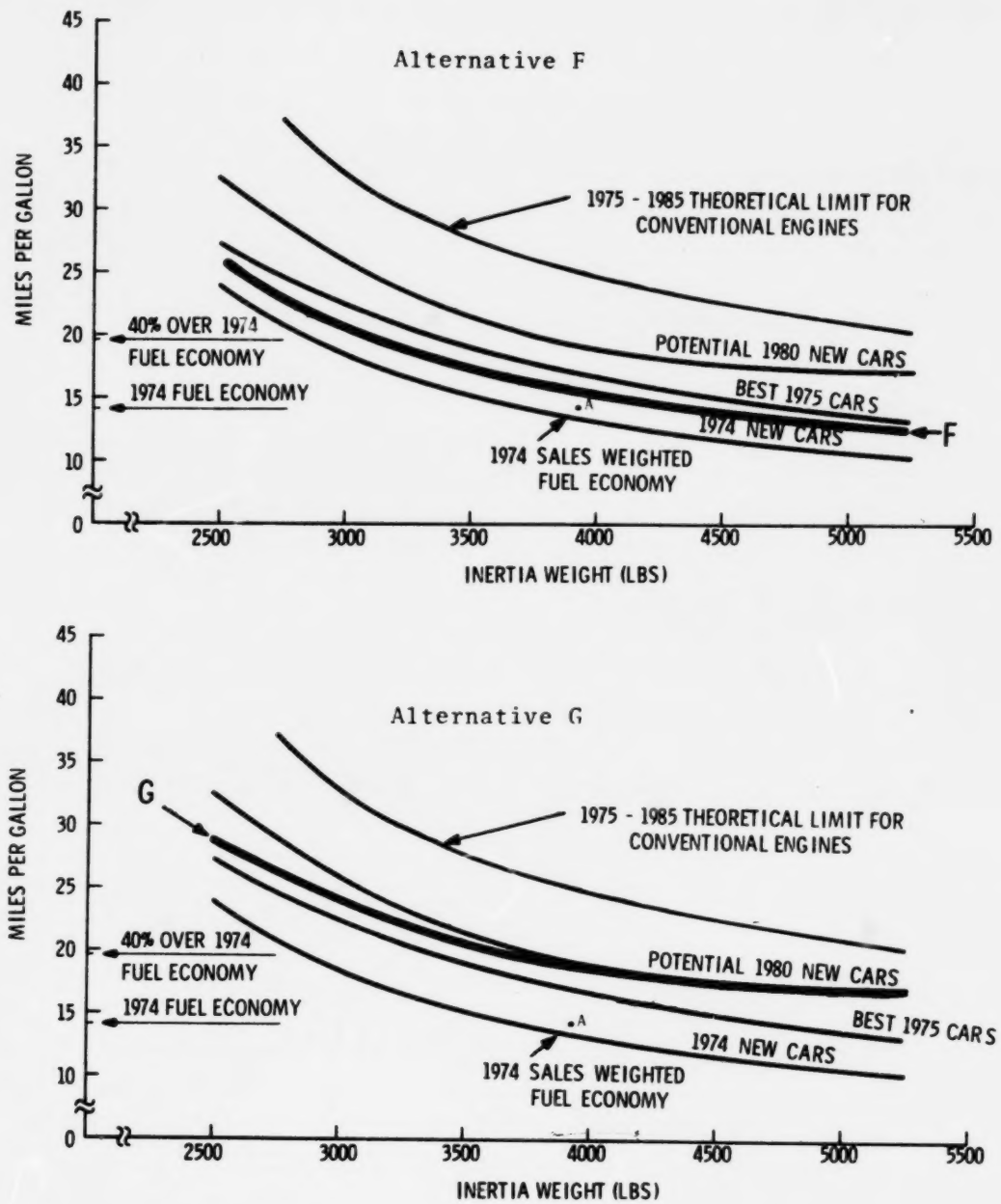


Figure 5 Projected Forms of Uniform Class Fuel Economy Improvement Standards

The imposition of any tax on vehicles designed to achieve national fuel economy goals involves the extensive evaluation of alternative tax bases and formulae, in terms of efficiency in achieving the goal and efficiency from the point of view of administration and compliance.

Two representative types of vehicle taxation were considered: a tax imposed directly on sales of new vehicles based on their fuel efficiency, and an annual tax on vehicles based on their fuel efficiency. As with the analysis of standards, the following is a comparable discussion of these forms of taxation as two means of achieving improved fuel economy on a national basis.

2.5.2 *Vehicle Excise Tax* (Alternative H)

A tax would be imposed directly on the sales of new vehicles based on their fuel efficiency. It would be progressive (e.g., exponentially increasing) so that it would increasingly dissuade purchases of autos with increasingly poor fuel economy. It would also inhibit the sale of cars with less than a specified level of fuel economy.

The Chase Econometrics Study (6) considered a variety of such taxes, two of which were:

$$\text{Tax} = \$175\ (20 \text{ mpg} - \text{specific mpg})$$

$$\text{Tax} = \$100\ (20 \text{ mpg} - \text{specific mpg})\ e^{.1(20 \text{ mpg} - \text{specific mpg})}$$

The second formulation works out to a tax of $110 on a 19 mpg auto and a tax of $3,984 on an 8 mpg auto.

Any comparison of what the manufacturers reaction might be under a tax alternative with their reaction under a regulatory standard suffers from the fact that manufacturers' compliance would not be mandatory under the tax, and would be only indirectly determined by the forces of market prices. Producers are thus free to accommodate the tax at their own pace, balancing the resulting increase in price against the technological upgrading which would forstall it. However, given the competitive significance of first costs, they cannot be as indifferent to the excise tax as they might be to the labeling alternatives described in

Section 2.2 above. In addition, the excise tax will provide continuing, unrelenting impetus for continued improvement beyond 1980, because any gain in performance will reduce the tax on individual models and thus lower first cost.

From the point of view of general tax policy, utilization of an excise tax to enhance economy in fuel consumption would be inconsistent with the structure of the Federal excise system. Although it was customary at one time to use excises to control or prevent the production of certain products, this approach became less common as the Federal Government developed systems of direct controls on such items as foodstuffs, drugs, and the banking system. As a result, excises of this type have gradually been phased out of the law or became obsolete even though still on the books. Further, this type of tax appears to be inconsistent with government policy as expressed in the Excise Tax Reduction Act of 1965.

The cost of administration will vary depending upon whether the tax is applied at the dealer level or the manufacturer level. Taxes levied at the manufacturer level have the advantage of requiring supervision of a much smaller number of taxpayers than retail or user taxes. Furthermore, from both the point of view of the Government and taxpayers, the manufacturing level is preferred because manufacturers, being large economic units are accustomed to keeping records for excise tax purposes and have a staff which is better able to comply with the technicalities of law and regulations.[1] The reason usually advanced for collecting an excise tax on the sale of a product at the retail level is that it relieves the retailer of the need to finance the tax while he is holding the product in inventory.

The effectiveness of this alternative requires an evaluation of its efficiency as a control measure. It is relatively simple to devise an excise tax that will serve to cut off entirely the use of a given product or service if there is an adequate substitute

[1] At the present, most manufacturers (and some importers) of passenger vehicles already are paying excise tax on trucks and buses with a gross vehicle weight of over 10,000 pounds.

involved, an example being the tax (still in the law) of 2 cents per hundred on white phosphorous matches. But where the intent is not to entirely suppress a product but to restructure the product mix or technology so as to achieve a stated level of achievement (i.e., a 20% fuel saving), the problem becomes much more difficult. While the Government has some knowledge of the effect of an equal *ad valorem* tax on all auto sales, it is impossible to forecast with any degree of assurance the reaction of the automobile market to a differential set of rates for cars having different performance characteristics. Lacking such knowledge, there is some risk that the tax could fail to achieve its purpose, or by "over-achieving" could unduly interfere with consumer choice with the associated burden on products.

Tax laws, by their very nature, do not lend themselves to quick adjustment if an error is made. It takes some time for the economic effects to become noticeable and even when they do a further lag is involved in obtaining new legislation. As a consequence, business operations may be affected in an undesired manner for some time. And there would be no assurance that a revised tax also might not miss the mark, especially since supply and demand conditions are changing all the time.

It is this type of uncertainty and probably adverse results as to effect that reinforces the position espoused by many that excise taxes should not be used to affect the structure of an industry and influence consumer choice.

2.5.3 *Annual Vehicle Fuel Efficiency Taxes* (Alternative I)

An annual tax (similar to the personal property tax now imposed in some jurisdictions) would be levied on all vehicles after a selected future model year. It would be inversely related to fuel economy, and would reinforce consumers' demand for better fuel efficiency in new vehicles. Depending on how it was structured, it could be made to encourage earlier retirement of vehicles with poor fuel economy. However, this would have a regressive effect in that the poor, who frequently own old inefficient cars and often cannot afford new car prices would be the hardest hit.

Public reaction to annual use taxes for vehicles has been somewhat less than enthusiastic. Part of the problem is the mere mechanics of making payment. Additionally, there seems to be a different attitude toward Federal use taxes than, say, the Federal gasoline tax. This may be due to the fact that other Federal taxes on automotive products are included in the price charged by the retailer and thus, except for the tire tax, are not explicitly stated. A use tax was levied on motor vehicles during World War II and, one is now in effect for heavy trucks and buses. There also is an annual use tax on airplanes. Both the heavy truck and airplane tax involve a small fraction of the number of taxpayers that a tax on motor vehicle owners would involve. Although there are less than 500,000 truck use tax returns filed annually, its collection has been considered less than optimal because of the difficulty of securing records as to those liable for the tax and the work necessary to follow up when delinquencies are determined.

When the tax on passenger cars was in effect in early 1971, there were less than 500 tax payers. At the retail level there are reportedly 35,000 or more dealers in new cars. With well over 100 million registered motor vehicles, the number of vehicle owners overwhelms the number of producers or retailers, and the costs of administering the tax escalates commensurately.

The tax could be collected as part of each state's registration procedure. There are difficulties, however, in that federal taxation and state motor vehicle registration periods do not coincide, state employees would be required to become familiar with the new federal law, and arrangements would have to be worked out with each state. Another administrative problem would be that of establishing mpg figures for every car model and accessory combination on the road. All of these are time consuming and again there is little assurance that, once set, the tax would produce the desired effects.

3. EVALUATION OF ALTERNATIVES

The preceding section briefly outlined the implementation strategies studied. Although a diverse group of alternatives, ranging from almost complete reliance on market forces to various forms of government intervention, they have in common the characteristics that each is directed at the vehicle itself, and each is capable of inducing improvements in auto fuel economy. The next step is to develop a means by which to identify the comparative merits and deficiencies among this set of candidates.

One way in which this can be done is to consider seriatim the pros and cons of every attribute of each strategy under consideration, a procedure which does little to reduce the complexity of the problem. In contrast more immediate insights are gained if all of the alternative strategies can be compared systematically on a uniform basis. This chapter describes first the development of suitable criteria by which such a comparison can be made, and then the results attained through that analysis.

3.1 DEVELOPMENT OF EVALUATION CRITERIA

As noted in Section 1.8 the evaluation of the various implementation strategies should be done in terms that reflect the dynamics surrounding their imposition. The impact on the manufacturers must be considered, as well as the ways in which they will accommodate the standards, and even the measures that can be taken by them to thwart its purpose. Similarly, the impact on consumers must be determined, as well as what their reaction might be. Finally, it is necessary to consider how difficult it would be to administer the standards, as well as what pressures might evolve upon the administering agency, and what actions they might take in response to the various possible reactions by the producers and consumers.

The development of criteria that would be responsive to these particular considerations began with a tabulation and listing of the attributes or measures used by others to evaluate policies in

previous analyses. Both qualitative and quantitative dimensions were included. This list was then culled for those which would facilitate comparisons of the impacts on producers, consumers, and the administrative agencies. New measures were developed and added as appropriate to more adequately recognize and bring out the differences sought. Finally, after several tests, it became apparent that because of the qualitative nature of this process, comparisons made on some measures yielded differences which were highly subjective, or sufficiently lacking in discrimination that they became questionable and uninformative. A number of criteria originally considered for use were eventually rejected on that ground. The following describes the criteria which were retained.

3.1.1 Impact on Producers

a. Producer Flexibility - The degree to which the manufacturer can exercise choices in complying with the requirements, e.g., technological improvements, shift to small car production, etc.

b. Incentive for Post 1980 Improvement - The degree to which the alternative will motivate the manufacturer to further invest in order to continually improve the fuel efficiency of his vehicles.

c. Comparative Impact on Producers of Efficient Models - The degree to which the alternative unfavorably impacts those auto manufacturers who through their own initiative have already upgraded the fuel efficiency of their models.

3.1.2 Impact on Consumers

a. Increase in First Cost of Autos - The increase in price of new automobiles caused by compliance with the standard.

b. Distribution of Cost Increases - The degree to which the resulting increase in first cost impacts the larger vis-a-vis the smaller models.

c. Maintenance of Consumer Choice - The degree to which the standard limits the choices of automobiles available to the consumer.

d. Safety Costs - The degree to which consumers are induced to buy lighter, and therefore less safe cars; or the degree to which the consumer must pay more in first cost to maintain present levels of occupant safety.

3.1.3 Impact on Administration of the Standard

a. Reliance on the Market - The degree to which the strategy alternative relies upon market price and consumer preference signals to achieve the standard, thereby minimizing administrative intervention.

b. Cost of Administration - The comparative costs of the requisite new agency necessary for administration of the standard.

c. Effectiveness of Ensuring Achievement - The degree of assurance that the standard, expressed as the desired increase in fuel economy of 1980 model year motor vehicles, will be obtained.

The evaluation intentionally excluded the ramifications of emissions, and effects on the national economy that might be implicit in the various implementation policies. It was determined that activity in those areas of concern would be relatively independent of the alternatives evaluated here, (excluding perhaps the exercise tax). Extended discussions of both effects will be found in the Air Quality and Emissions Panel and the Economic Panel Reports and are summarized in the Report to the Congress.

3.2 COMPARISON OF ALTERNATIVES

3.2.1 Analytical Methodology

Having established criteria by which comparisons can be facilitated, the next step in the analytical process is to rank the alternatives to see which, if any, is preferred over the other.

In order to do this, each strategy was analyzed on a criterion by criterion basis.

The descriptions found in Section 2 represent a distillation of the results of that effort. Although pertinent to the criteria just cited, the discussion did not allude to them specifically because such constant repetitious references in the flow of the text become quite tedious. For readers with a high level of interest, each of the nine alternative strategies is described in detail, in terms of the ten criteria, in Appendix B.

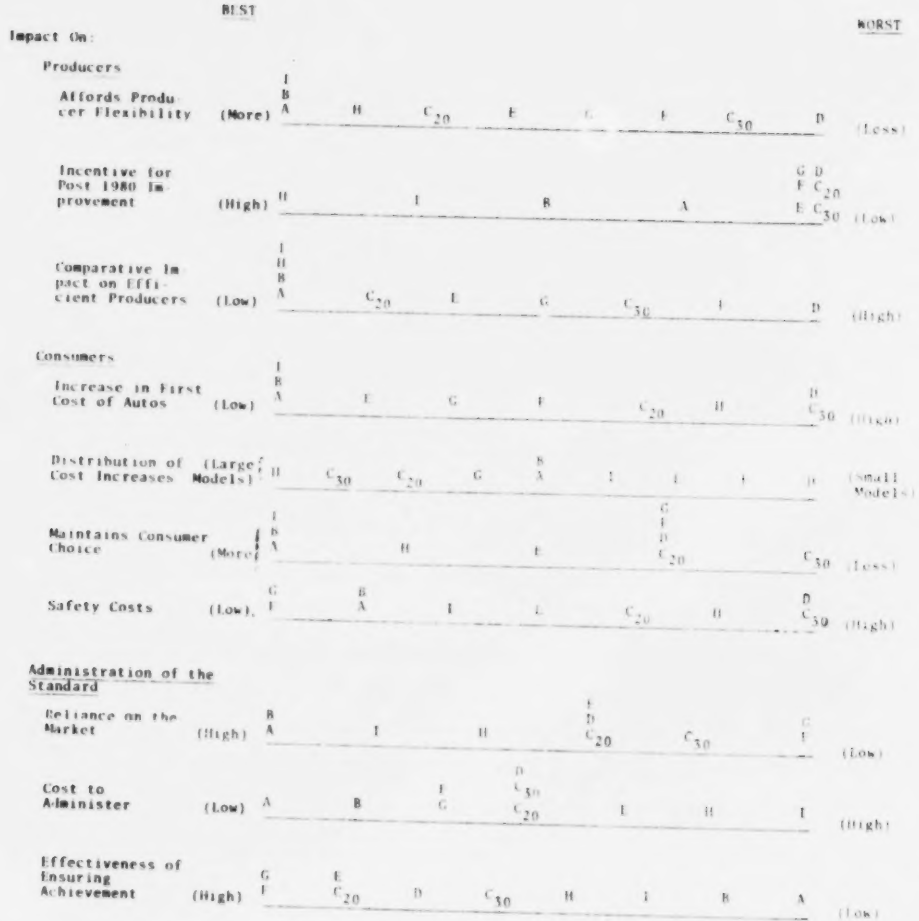
By following such a procedure, it was possible to undertake the comparison of the different strategies, and to rank them in an ordinal fashion for each criterion. The ranking process was in its own right somewhat subjective. However, it was not nearly as arbitrary as might be the process of attempting to quantify the comparison, which would involve trying to rate a set of highly complex and multifaceted courses of action by assigning single numerical values to them.

The results appear in Figure 6. It diagrams the ordinal ranking of each policy alternative in terms of the assessment criteria. Where clear differences were not discernable, they were assumed to be of equal rank, and placed in the same position. For example, no basis could be found for expecting that the increase in first cost of autos would be any different whether Alternative A, B or I were applied.

This type of evaluation is necessarily subjective and imprecise in light of the complexities involved. Because the ranking is an ordinal one, no interpretations about the absolute position of any alternative along the dimension for any criterion should be made. The spaces between them have been evenly divided, depending only upon the number of ranking positions that became necessary.

3.2.2 Findings

a. General Comparison - It may be seen from Figure 6 that none of the various forms of Government action emerge as clearly preferable over all the others. Each has



A. Voluntary Fuel Economy Goals and Labeling
B. Mandatory Fuel Economy Labeling
C. Production Weighted Average Common Standard* (16.8 mpg. for all mfrs. at 20%, 18.2 mpg. for all at 30%)
D. Production Weighted Average Uniform Percentage Improvement Standard (20% improvement for all)
E. Production Weighted Average Variable Improvement Standard (Unique standard for each mfr.)
F. Class Standard - Uniform Fuel Economy Improvement for each (2.8 mpg for all classes)
G. Class Standard - Variable fuel Economy Improvement for each class
H. Vehicle Excise Tax
I. Annual Vehicle Fuel Efficiency Tax

*20% (C_{20}) and 30% (C_{30}) improvement illustrated. All other standards are 20%

Figure 6 Ordinal Ranking of Alternatives

pronounced strengths and weaknesses. For example, under Administration of the Standard, alternatives which appear more favorable in terms of Reliance on the Market appear less favorable in terms of Effectiveness of Ensuring Achievement.

Another problem in performing the comparisons is the need to properly portray the fact that the results of imposing alternative implementation strategies will vary, depending upon how stringent the improvement objective. This was resolved by selecting one strategy out of the group, and indicating the comparative effects for both a 20% improvement and a 30% improvement. These are portrayed in Figure 6 by the two standards: C_{20}, a common production-weighted average improvement of 20% (16.8 mpg for all manufacturers); and C_{30}, a common production weighted average improvement of 30% (18.2 mpg for all manufacturers).

In response to the Act, the remaining implementation strategies in Figure 6 are predicated on a 20% fuel economy improvement. Unfortunately, this is the level at which the ranking is the most subjective because the 20% target can be made relatively easily. Since there are a number of ways by which a 20% improvement can be achieved by the manufacturers, finding differentiation between the impacts of different strategies becomes that much more difficult.

For readers who wish to closely follow the analysis, a detailed explanation of the rationale underlying the ranking of the alternatives and their resultant placement will be found in Appendix C.

b. Search for Dominance - It should be noted that the dimensions for each criterion in Figure 6 have been laid out so that the preferred degree is on the left, under the caption "Best," (e.g., more Producer Flexibility is preferred; a high Incentive for Post 1980 Improvement is preferred) while the more undesirable degree is on the right

under the caption "Worst" (e.g., high Increase in First Cost of Autos; less Maintenance of Consumer Choice). Under that type of arrangement it becomes apparent that any alternative is totally preferred to another if it is consistently to the left of the other. In that case, the left most one is said to *dominate* the other.

If one alternative is found to dominate all of the others for all criteria, it is clearly the preferred one, and the one which should be recommended. Similarly, if one alternative is found to be dominated by another, it may safely be ruled out, since nothing can be accomplished by it that cannot be accomplished in as good or better a way by the alternative that dominates.

Two alternatives may immediately be seen to be dominated. First, alternative C_{20} dominates alternative D, i.e., C_{20} is never to the right of D. Therefore, nothing can be accomplished by D, the standard requiring a Uniform Percentage Improvement of 20%, that cannot be accomplished as well or better by C_{20}, the common standard of 16.8 mpg for all manufacturers. Secondly, alternative G dominates alternative F, i.e., G is never to the right of F (although they are often in the same position). This is not surprising if it is remembered from Section 2.4.3 that alternative F, the Uniform Class Standard is a special case of alternative G, the Variable Class Standard.

With these two exceptions, none of the alternatives emerges as clearly preferable over the others. When all of the dimensions are taken into account, each strategy has some merits, and each has some shortcomings.[1] It would be possible to initiate a search for alternatives that demonstrate partial dominance (e.g., dominance attained in 8 out of 10 of the dimensions) but this would involve an arbitrary determination of the importance of one of the criteria over the other.

[1] The search for dominance may be facilitated by a visual procedure in which the positions on the chart of each alternative are connected with a uniquely colored line. The results of this procedure failed to reveal any additional dominance.

The results of the ranking shown in Figure 6 indicate the deeply complex nature of the problem and the reason why no recommendation can be made of one alternative as the preferred strategy. It is unfortunate that in the time available it was impossible to consider either phased standards, or mixed strategies, both of which are worthy of future investigation, and may produce superior results.

4. ENFORCEMENT

The Act specifically inquires about the matters of test procedures required to determine compliance and various means of enforcement. From the description of strategies in Section 2, it is apparent that no matter which is adopted, it cannot be implemented in the absence of well-developed procedures for fuel economy measurement, labeling and enforcement. The first two of these were discussed above in Sections 1.4 and 2.2; this chapter concentrates on matters of enforcement.

The nature of enforcement schemes will vary somewhat with the form of the standard adopted. If not established by statute, the standards themselves would have to be established by the responsible agency after accumulation of a sufficient data base and after allowing reasonable time for industry and public input. Given the complexities of the development and promulgation of regulations, this could take as long as one year. Once the standards were established, a similar effort would have to be devoted to the implementation of viable enforcement schemes to ensure compliance with the standards.

Enforcement schemes may take a variety of forms, but each requires test and certification procedures, test facilities and effective remedial procedures with appropriate safeguards. These must be developed giving careful consideration to the judicious balance between the preservation of the industry's due process and the need for strong, quick government action. This effort may also take up to six months time, although this period can be shortened where resources already exist in the form of test facilities and qualified personnel. Even if government testing is not required, time will still be necessary for private industry to establish acceptable testing methods.

4.1 TEST AND CERTIFICATION

A number of options for this function are available:

a. Pre-production certification - Each manufacturer would be required to certify the average fuel economy of his fleet by submitting a statement of his predicted production mix and having a representative number of prototype vehicles tested for fuel economy to verify that the average standard will be met. Upon demonstrating this, the manufacturer would be certified and allowed permission to produce and sell vehicles. The proper number and mix of vehicles to be tested is a problem which is yet to be resolved.

   Certification is most appropriate where the standards are sufficiently stringent that they force technological improvement and it is desirable to prove that the technology has been attained prior to production. Further, certification may also be preferred where the fuel economy standards are required to be met throughout the life of the vehicle and the possibility of degradation exists.

b. Assembly Line Test of Production Vehicles - Under this scheme production vehicles at the manufacturer's plant are selected at random in accordance with a sampling plan determined in advance. These vehicles are then tested to see whether the manufacturer's production fleet is in compliance with the average standard. Assembly line testing has an additional advantage when compared to certification in that actual production vehicles are tested rather than prototype vehicles. Difficulties which may be expected to be encountered in all testing are described in the Fuel Economy Test Procedures Panel Report, as well as Section 3.2.2 of the Report to the Congress.

c. In-use Vehicle Test - This scheme involves selected tests of vehicles in use to see whether their level of fuel economy remains acceptable. The utilization of such a

procedure would depend on the extent to which legislation mandated the fuel economy standards to apply. This would involve the creation of a vehicle use life over which the standard should apply. Appropriate deterioration factors could be recognized to account for vehicle wear. Due to the difficulty in effecting a useful sampling plan under this scheme, consideration could be given to ascribing a minimum level of fuel economy to each vehicle family in the manufacturer's fleet. The in-use approach conceptually adopts a remedial concept whereas certification and assembly line testing are more in the nature of preventive concepts.

d. Combinations of the above - The enforcement mechanism associated with a fuel economy standard can be implemented with government performing all refined testing, industry performing all testing with government surveillance, or a combination where both industry and government perform testing. The industry testing approach is the least disruptive in terms of cost and government intervention but does not offer as high a degree of certainty that the fuel economy goal will be met as in the case where some government testing is involved.

In the case where government testing is contemplated in the enabling legislation, the issue as to whether the cost of such testing should be paid for by the general public or the vehicle buyer is raised.

In the event it is desirable that the cost be associated with the product, a government testing user fee should be provided for.

4.2 REMEDIAL PROCEDURES

In addition to the testing options which are available, different remedies are possible. Some of these are:

a. Civil Penalties - The assessment of fines against manufacturers based in some manner on the number of violations

which occur, the severity of the violations, and the voluntary steps taken by the manufacturers to rectify any violations.

b. Recall - The authority to order manufacturers to recall and fix vehicles which are responsible for the manufacturer's failure to meet standards. As an alternative the manufacturer could be required to submit a plan on his own detailing the steps he would propose to take to remedy any violations, including, for instance, elimination of certain models or some other significant shift in production mix.

c. Warranty - The requirement for each manufacturer to warrant a certain fuel economy for each vehicle to each individual purchaser. The fuel economy warranted would have to be that which was required of that model so that the standard would be met. Breach of this warranty would give consumers some form of action independent of government action. This remedy would be easier to implement where vehicle class standards were in effect. Warranty appears to be the most effective of all the remedies and would reduce the need for the use of government enforcement tools.

5. CONCLUSION

The above analysis has reviewed a variety of alternative strategies by which to achieve the desired 20% or higher improvement in auto fuel economy. They range from almost complete reliance on market forces to various forms of Government intervention. As indicated in Figure 1, a 20% or greater improvement may be reached solely through the forces of the market. At that level it is not clear that any form of intervention would be needed. However, when more stringent goals are to be considered, the above analysis should be of use in the deliberations as to which implementation strategy should be adopted.

With respect to the regulatory alternatives, none appears dominant, or to recommend itself above the others. Each involves costs and risks. It may be concluded, however, that as a Federal regulatory policy becomes stronger, the certainty of achieving given fuel economy goals will be increased. But stronger Federal regulation also involves higher risk of adverse impacts on industry, consumers, and Government administration and requires coordination with safety and emission programs.

Fuel economy standards based on a production weighted average have the effect of restricting market forces to some degree while also providing impetus for technological advances. They do however, represent substantial monetary and enforcement difficulties, since it is presently unknown to what extent the sales mix can be controlled by the manufacturers. A production weighted standard requiring every manufacturer to improve the average fuel economy by the same percentage (20% improvement for all) would impact unfairly on manufacturers of already efficient cars for whom it would not be economically feasible to improve the fuel economy of their vehicles. A production weighted standard establishing one uniform specific fuel economy average for all manufacturers would most heavily impact manufacturers with lower average fuel economy while not requiring improvement of those with already high average

fuel economy. A variable production-weighted standard on the other hand would eliminate some inequities, but constrains producer flexibility and would probably be more difficult to administer.

Establishing standards on the basis of class would have the effect of inducing technological advances for vehicles of all classes while allowing maximum consumer choice. As shown in Figure 1, line 2, an average fuel economy of 18.9 mpg could be reached by improved technology alone, without engine resizing. Including engine resizing, (line 3) improved technology could result in 20.3 mpg improvement. Class standards would not necessarily ensure attainment of an overall fuel economy goal because of some possibility of increased sales of larger (although improved) models. However, this demand may be assumed to prevail irrespective of any standard if given improved larger cars.

The taxation alternatives are of questionable use because it is not known what level of taxation will produce a given level of improvement in fuel economy. Inherent in this problem is the difficulty that there is considerable time lag before the relationship between the level of a given tax and its effect can be calibrated, and the fact that such calibration is all the more difficult because the forces of supply and demand in the marketplace are in constant flux. Further, by their very nature, once tax laws are in effect, they are difficult to change. Taxation would also be the most expensive alternatives of those examined.

Mandatory Fuel Economy Labeling is straightforward, non-discriminatory and most consistent with market forces. It does not ensure a 20% or better fuel economy improvement by 1980. However, since the administrative testing, and public information requirements inherent in it are fundamental to any implementation policy, adoption of Mandatory Fuel Economy Labeling could reasonably precede more stringent standards.

None of the strategies emerge as clearly preferable over all the others, each having pronounced strengths and weaknesses.

APPENDIX A

MATHEMATICAL DERIVATION OF VARIABLE STANDARDS

A. Let

N_i = the number of autos projected to be sold of type i in 1980,

m_i = the increase in mileage of autos of type i (i.e., the increase in the number of miles traveled with one gallon of gas),

c_i = the increase in cost for a new auto of type i necessary to attain m_i. It is thus a function of m_i, or:

$$c_i = C_i(m_i) \tag{1}$$

$m_i N_i$ = the production weighted increase in mileage for type i.

B. Then the national improvement in mileage, M, may be expressed as:

$$M = \sum_i m_i N_i = K \sum_i m_i^o N_i^o \tag{2}$$

where m_i^o was the mileage attained by type i and N_i^o was the number of cars sold in 1974. The constant K is equal to 20% for the 120 day study mandated by Congress, and is equal to 40% under President Ford's October 8 address.

M will be achieved at some total cost to the nation C. Then

$$C = \sum_i N_i c_i$$

or from (1):

$$C = \sum_i N_i C_i(m_i) \tag{3}$$

C. The problem is one of how to achieve M at a minimum cost. The equation to be minimized is:

$$C = \sum_i N_i C_i(m_i) - \lambda(\sum_i m_i N_i - K\sum_i m_i^o N_i^o). \quad (4)$$

where λ is the Le Grangian multiplier based on the constraint (2). The variable to be determined is what objective m_i should be established for each auto type to achieve minimum cost. Thus, the first order conditions for minimization of cost are:

$$\frac{\partial C}{\partial m_i} = N_i \frac{\partial C_i}{\partial m_i} - \lambda N_i, = 0 \text{ for all } i \quad (5)$$

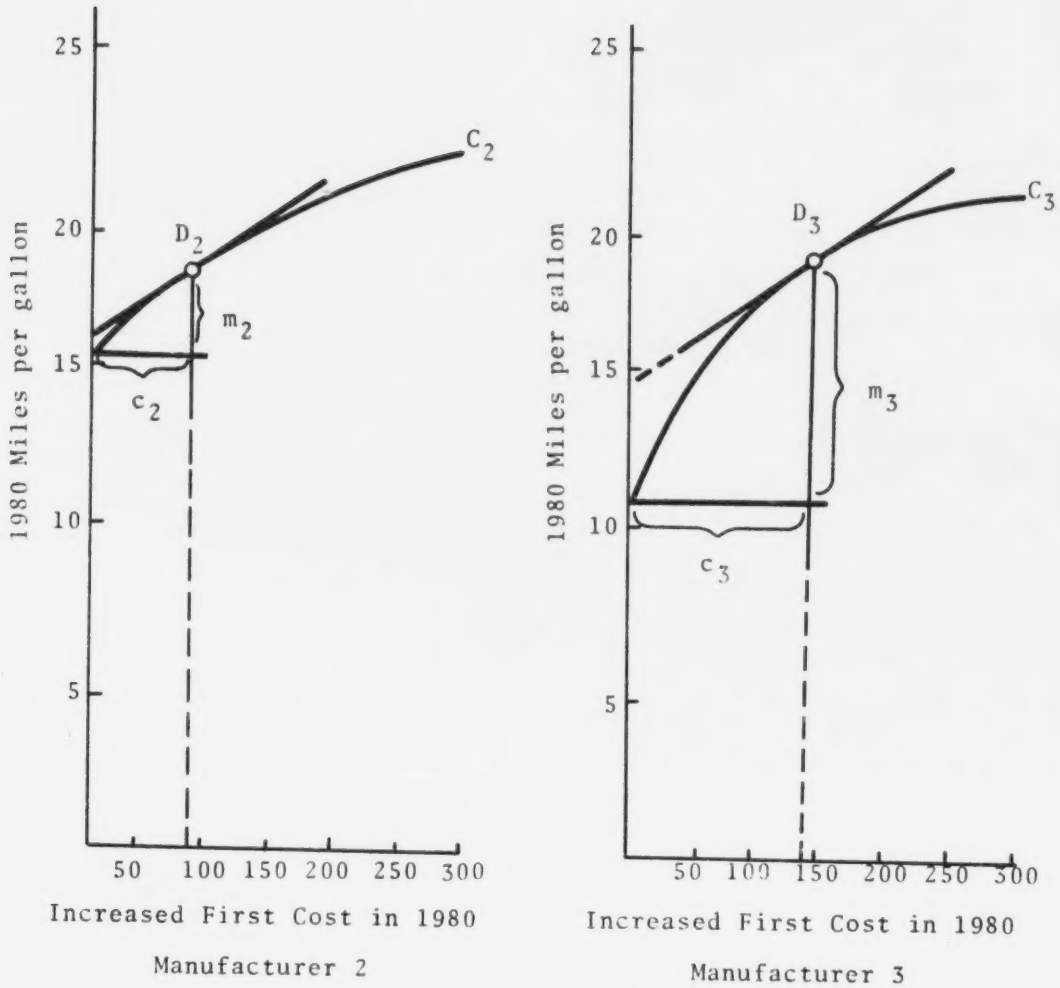
$$\frac{\partial C}{\partial \lambda} = \sum_i m_i N_i - K\sum_i m_i^o N_i^o = 0 \quad (6)$$

From (5), it may be seen that the marginal cost of improved mileage would be equal for all types of vehicle, or

$$\frac{\partial C_i}{\partial m_i} = \lambda \quad (7)$$

D. Once the cost functions C_i for all types are known, the first order conditions could be solved and each types' c_i and m_i could be found. This would determine a different mileage improvement for each type auto. This solution would achieve the goal at minimum cost, but assumes that sufficient knowledge of the cost structures can be developed and an appropriate administrative structure devised to closely equate the marginal costs.

E. The results may be seen graphically in Figure A-1. In it C_2 and C_3 represent the cost functions C_i for autos of type 2 and autos of type 3. The intercepts with the vertical



m_i Represents the increase in miles travelled with one gallon of gas for 1980 cars of type i

c_i Represents the increase in unit cost to achieve m_i

C_i Represents the function which relates m_i to c_i

Figure A-1 Cost Curves for Improved Mileage in Vehicles of Two Hypothetical Manufacturers

axis represent the mileage that can be achieved in 1980 with no increase in cost. For a type 2 auto, this is 15.2 mpg, while for a type 3 auto it is only 10.6 mpg. The cost minimization procedure establishes equal derivatives for all types, which turns out to be at point D_2 on C_2 and point D_3 on C_3. As a result, auto type 2 is required to increase it's mileage from 15.2 to 18.2 or 3 mpg. This will add about $85 to its costs. In contrast, auto type 3 is required to increase its mileage from 10.6 to 18.5, or 7.9 mpg. This will add a cost of $140 to it.

F. In the above derivation the goal is expressed in terms of an increase in mileage. An alternate way of expressing the goal, which is more in line with the general aim of energy conservation, would be in terms of a decrease in gallonage consumed by the fleet to travel the same number of miles (i.e., a reduction in gpm). Since this change can alter the conclusions of the analysis, a derivation based on this goal is also presented.

In addition to the designations of A above, let

g_i = the decrease in gallons consumed per mile (gpm) for autos of type i, (i.e., $g_i = \frac{1}{m_i}$)

c_i' = the increase in cost as in c_i, but now expressed as a function of g_i. Thus

$$c_i' = C_i'(g_i) \tag{8}$$

G. If the new goal is a national reduction in gallons consumed per mile, G, then the constraint may be expressed:

$$G = \sum_i g_i N_i = K' \sum_i g_i^o N_i^o \tag{9}$$

where g_i^o is the gallons per mile attained by type i in 1974. K' is the objective expressed as a reduction in gallons per mile, and therefore is negative. Note that K' would not be of the same magnitude as K (i.e., a 40% increase in mpg is equivalent to a 28.6% reduction in gmp; in general $K' = \frac{1}{1+K} - 1$).

H. The equation to be minimized is now:

$$C' = \Sigma_i N_i C_i(g_i) - \lambda'(\Sigma_i g_i N_i - K' \Sigma_i g_i^o N_i^o) \qquad (10)$$

I. Without presenting the first order conditions of this new minimization, it is apparent that:

$$\frac{\partial C'_i}{\partial g_i} = \lambda' \qquad (11)$$

In this case the marginal cost of a decrease in fuel consumption is also equal for each type.

J. Since it may be assumed that each type car will be driven about the same number of miles, then Equation (11) implies that the least cost method of saving gasoline has been achieved for new cars. The outwardly similar Equation (7) does not have this implication. The connection with total fuel consumption is lost because with that goal (Equation (2)), an increase in mileage from 10 to 11 is equated with an increase from 20 to 21 or 30 to 31 despite the fact that each of these has a different effect on the number of gallons consumed. The economic significance of this is quite substantial. Under Equation (7) the benefit from increased mileage by low mileage (mpg) cars is understated, whereas the benefit from increased mileage by high mileage cars is overstated. A policy based on this goal could cause

distortions through its impact on large and small cars. For this reason it is desirable to restate the goal in terms of fuel consumption.

K. The above derivation has not been specific as to whether type applies to manufacturer, class, or model. It would be possible to apply the same rational to any of those three levels, with appropriate variation to recognize the different forms that weighting would take at the different levels.

APPENDIX B

ANALYSES OF STRATEGIES BY CRITERIA

The strategy alternatives are generally described in Section 2. The criteria by which the alternatives were analyzed and compared is described in Section 3.1. This Appendix provides an analysis of each strategy in terms of each criterion. Selected text from Section 2 have been repeated here to make this Appendix more self contained.

1. FUEL ECONOMY LABELING (Alternatives A and B)

Comprehensive labels detailing economy would be placed on new vehicles for sale with certified fuel economy test results. Manufacturers would be required to use official test results in all advertising of new models. Variations under this policy would be:

(A) Voluntary Labeling - current EPA and FEA programs - compliance discretionery

(B) Mandatory Labeling - all manufacturers and dealers must comply

a. Producer Accomodations - Under this option each producer could decide on his best strategy for responding in the market to consumer reaction to the stated fuel efficiency of his models. This would entail the altering of production mix and the introduction of technological improvements.

(1) Producer Flexibility - Affords maximum flexibility for producers.

(2) Incentive for Post 1980 Improvement - Focuses public and industry attention on fuel economy as a competitive factor which will continue past 1980.

(3) Comparative Impact on Efficient Procedures - Places those already producing efficient models in a better position to respond.

b. Consumer Reaction - How fuel economy labelling will effect consumer reaction is unpredictable, but this strategy does assume that increased public awareness with stress on operating costs as a decision variable will alter traditional buyers' habits, bringing about a new car mix with improved fuel economy.

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(1) Increase in First Cost of Autos - Production disruptions directly attributable to labeling requirements would be minimal as would increases in first cost.

(2) Distribution of Cost Increases - Cost increases would be expected to be about the same for large or small models.

(3) Maintenance of Consumer Choice - Does not restrict consumer choice in any way.

(4) Safety Costs - Since a shift to lighter cars would be expected, more of the population at risk would be in lighter cars, and safety costs would be higher.

c. Administration of Standards - Under this alternative the responsible agency would become heavily involved in developing the labeling format, and administering and certifying test results. In addition, an enforcement scheme would need to be developed in order to ensure that manufacturers were labeling as required, and with accurate information.

(1) Reliance on the Market - This strategy relies totally on the free market (e.g., consumers' demand for more efficient vehicles would provide producer incentive) rather than federal intervention.

(2) Cost to Administer - The cost to administer would be lower than any other alternative.

(3) Effectiveness of Ensuring Achievement of Standard There is little assurance that consumer response would be strong enough to ensure attainment of the goal.

2. PRODUCTION WEIGHTED AVERAGE STANDARDS (Alternatives C,D and E)

Under this category of alternatives, the responsible agency would establish a standard articulated as the production weighted average fuel economy of each manufacturer's entire fleet of new vehicles. Under these alternatives it is anticipated that manufacturers would be able to predict with reasonable accuracy their production mix over the course of each year and apply whatever combination of sales and technology is required to meet the

standard. The incentive is thus to improve the fuel economy on the models where it can be done at lowest cost, in order to enable the manufacturer to maintain sales of other less-efficient models.

a. Producer Accomodations

(1) Producer Flexibility - Each manufacturer would tailor its production as it sees fit, depending on the fuel economy of its own specific mix of models, their profit margins, and its production capability. As this standard becomes more stringent, the manufacturer may find its flexibility to be restricted by the inability to produce inefficient vehicles and still conform to the standard. Similarly, should market demand strongly tend toward large less-efficient cars, its sales must be limited, unless a substantial upgrading in performance is made.

(2) Incentive for Post 1980 Improvement - Once the standard is achieved, there is little incentive for post 1980 improvement. However, it could lead to the eventual introduction of improved technology if consumer preference for large cars remains stable and a manufacturer decides to concentrate on that market.

(3) Comparative Impact on Efficient Producers - Manufacturers with the poorest present level of fuel economy must improve the most. However, manufacturers of more efficient vehicles are not required to make any improvement (in fact, degradation is permitted). The competitive position of manufacturers of less-efficient vehicles would be adversely impacted.

b. Consumer Impacts

(1) Increase in First Cost of Autos - There would be some tendency for manufacturers to increase the price of smaller, historically economical cars to make up for the loss in profits of larger, historically higher priced cars. This would be mitigated by the need to maintain the average through sales of the economical cars, keeping them competitively attractive.

(2) Distribution of Cost Increases - The distribution of costs will vary depending upon which production weighted standard is chosen. This is discussed further below.

(3) Maintenance of Consumer Choice - A significantly reduced variety of cars in the model line could result through the dropping of high performance cars, specialty cars, or vehicles with the poorest fuel economy.

(4) Safety Costs - Because great emphasis would be placed on the lighter, more fuel efficient vehicles, more of the population at risk would be in lighter cars, decreasing occupant safety, and requiring improved safety features to maintain present safety levels.

c. Administration of Standards - Under this kind of strategy the Government adopts the goal, translates it into a production weighted average standard and mandates that it be met by the manufacturers. While this would appear to ensure the achievement of the overall objective, it presumes the manufacturer's capability to control their sales mix.

(1) Reliance on the Market to Achieve Standard - The manufacturers can only attain the standard by working through the market, exploiting whatever ability they have to influence sales of the more fuel efficient models.

(2) Cost to Administer - This type of standard is costly to administer because of the need to work closely with the manufacturers on their projected and attained production, and the averages that result.

(3) Effectiveness of Ensuring Achievement of Standard - At the 20% improvement level, manufacturers would be expected to accomodate the goal through technological upgrading more than shift in sales mix. However, considerable difficulties may be anticipated when the improvement objective is raised, or when consumer demand for larger cars prevails and the manufacturer's capability to supply within the constraints of the production weighted standard is exceeded. The manufacturer's ability to alter sales mix through raising profit margins on the large, inefficient cars, and exhorting buyers to select the small, more efficient ones is largely an untested and unproven concept.

Variations under this category are:

(C) a common standard (e.g., 16.8 mpg for all manufacturers),

(D) a standard stated as a uniform percent improvement (e.g., 20% improvement for each manufacturer),

(E) a variable standard based on the costs to improve fuel efficiency for each manufacturer.

A refinement of impact of these variations is as follows:

d. Impact on Producers by Alternatives C, D and E

(1) Affords Producer Flexibility - For any given level of improvement Alternative C would place a more difficult burden on those manufacturers whose annual production includes substantial numbers of large cars since they would have to improve more than manufacturers who already produce smaller, more efficient vehicles. Alternative D, the uniform percent increase in the production weighted average fuel economy for every manufacturer is the worst alternative. The best present fuel performers would be required to make the biggest absolute improvement; i.e., 20% improvement for a manufacturer producing cars with a weighted average of 10 mpg requires a 2 mpg improvement; while a 20% improvement for a manufacturer with a 25 mpg average would require a 5 mpg improvement. Thus, D places an especially difficult, disproportionate objective on those producers which have already utilized some of their technological options, with the result that they have fewer to choose from, and even less latitude of action.

(2) Incentive for Post 1980 Improvement - Little difference is discernable between Alternatives C, D, and E.

(3) Comparative Impact on Efficient Producers - Alternative C places those who have been working to improve fuel efficiency in a better position to meet the standard than those who have not. This may be demonstrated in the extreme if the 40% improvement standard were to be envisioned, and all manufacturers had to achieve a sales weighted average of 19.6 mpg. Using the fuel economy data published by EPA appearing in Table 2, GM would have to improve its fleet from their 1974 level of 12.2 mpg by

7.4 mpg or 61%. Ford would have to increase its by 5.2 mpg or 36%, Chrysler by 5.8 mpg or 42%, and AMC by 2.8 mpg or 17% over 1974.

Alternative D is patently unfair to those manufacturers who are already producing in the more efficient range because their past progress in this area now becomes a penalty in the form of a higher absolute requirement. The inequities of this may be demonstrated best by again resorting to our earlier example, but using a 40% standard applied to 1974 performance. In this case AMC (having already moved toward better fuel economy) with 16.8 mpg would have to achieve an absolute improvement of 6.7 mpg; in contrast, GM starting from 12.2 mpg, would have to achieve only a 4.9 mpg improvement.

e. Impacts on Consumers of Alternatives C, D, and E

(1) Increase in First Cost of Autos - Alternative D would force the already economical models to increase the most. Since accomplishing increased mpg is most expensive on the models which have already employed some of their technological options, this would raise first costs higher than the other standards of this category.

Alternative E will result in the most economical way to achieve the aggregate improvement objective, and therefore results in least overall increase in first cost.

(2) Distribution of Cost Increases - It may be expected that under Alternative C first costs of large cars (27% of the 1974 fleet) would increase a great deal, and medium size cars somewhat (45% of the 1974 fleet). These percentages would be changed by shift in mix, but in general there would result a relatively higher increased first costs for the bigger already more expensive models. At the same time, the need to maintain the competitive attractiveness of the smaller cars to encourage mix shifts may make their comparative price even less expensive.

Under Alternative D small good economy models suffer a disporportionate increase in improvement objective, which must be met through technological upgrading. Therefore,

relative price increases of small models will be higher than under any other alternative.

Under Alternative E the burden for the 20% improvement will be distributed across all models in the way which minimizes overall cost to the fleet. If it is demonstrated that more cost effective improvements can be made on larger models than smaller ones, their costs will increase slightly more.

(3) Maintains Consumer Choice - Alternative C could cause manufacturers to drop some of their poorest performing large models.

Under Alternative D manufacturers of the smaller models would similarly have to drop some of their less-efficient lines. There is no reason to believe the chances for this would be any higher or lower under C than under D.

Alternative E would match the increased level of cost with increased level of improvement. It also allows for accommodation by mix shift. It could possibly cause the elimination of some models, but would be less likely to do so than the other standards.

(4) Safety Costs - Under Alternative C there is pressure to eliminate the very heavy models, and more emphasis on promoting the smaller models, so the population at risk will be in slightly lighter vehicles. Under Alternative D, there is undue pressure to improve the smaller models so the light cars will be even lighter. A large proportion of the population will be in lighter cars and their occupants will be even less safe. Again, much of this depends upon the level of improvement selected.

Under Alternative E there are pressures to improve fuel efficiency of all models, the smaller cars as well as the larger. As a result, they will all get lighter and their occupants will be less safe, but the extremes of Alternative D will be avoided.

f. Impact on Administration of Standards of C, D, and E

(1) Reliance on the Market - At a given improvement objective, there appears to be little discernable difference in impact among the three alternatives.

(2) Cost to Administer - As with all standards based on production weighted averages, Alternatives C and D would require monitoring of production plans as well as the testing, rating and execution of enforcement procedures. Alternative E would be somewhat more expensive in the beginning because it would require an extensive determination of the extent to which various engineering changes result in mpg improvements, and the costs related to each, for each manufacturer.

(3) Effectiveness of Ensuring Achievement - Each of the Alternatives in this category of standards rely on the ability of the manufacturers to control their sales mix. Of these, Alternative D will be the most difficult and therefore would be the least likely to achieve.

3. CLASS STANDARDS (Alternitives F and G)

The responsible agency would classify all models into classes, perhaps according to their passenger capacity, or their weight. The improvement for each class would be stated as a minimum performance standard to be attained by every vehicle within that class. New models could not be introduced which did not meet their class standard.

a. Producer Accommodation - This kind of standard provides some incentive for fuel economy improvement for the whole range of vehicle types. Existing models which out perform the standard would remain unchanged, but it is assumed that technological improvements would be required for most models. An estimate of the extent to which higher mpg performance of the nations fleet can be realized through technological improvements is shown in Figure 1, line 2.

(1) Affords Producer Flexibility - Producers have the choice of upgrading existing models, shifting to models in a different class but adhering to that standard, or dropping some models. In addition, depending upon what improvement objective is chosen, there may be a number of technological alternatives by which to achieve the standard.

(2) Incentive for Post 1980 Improvement - While models in all classes become good economy performers, there would be little incentive for continued improvement unless there is a phased standard.

(3) Comparative Impact on Efficient Producers - Today, within any given class, there are more efficient and less efficient models. Since fuel economy improvements would be required across the whole spectrum of classes, those manufacturers who have already improved efficiency of specific models would have less upgrading to do. Those who produce any inefficient cars, small or large, would have to upgrade them or drop them.

b. Consumer Impacts

(1) Increase in First Cost of Autos - Increase in first cost will depend upon the extent to which the burden of improvement and their resultant costs are distributed over the entire fleet. Class standards assure that the burden will be distributed more evenly over the entire line of models, from small to large. It will probably not do so as equitably as would be possible under Alternative E, the variable production weighted standard, which does this on the basis of the marginal cost of improvement for each manufacturer. Thus, increases in first cost would be less than under alternatives C or D, but higher than under Alternative E.

(2) Distribution of Cost Increases - The distribution of costs will depend upon which class standard is chosen. See 3-e(2) below.

(3) Maintains Consumer Choice - Under class standards, consumer choice would be unaffected, except to the extent that very inefficient models are eliminated. It is

unclear whether there would be more or less choice than under production weighted average standards.

(4) Safety Costs - If the classification scheme is by weight, it does not encourage the weight reduction that would decrease occupant safety. In fact, there would be a tendency for cars to become heavier as manufacturers redesign in the direction of standards with lower mpg values.

c. Administration of Standards

(1) Reliance on Free Market - In the actual administration of the standards, there is little reliance on the free market. Manufacturers can sell all they can of any class of car as long as it out performs the standard for its class. However, in the determination of what standards would be required to achieve the overall national improvement objective, some assumptions about future market mix would have to be made. The higher the level of uncertainty that prevails about the future directions of the market, the higher the safety factor that would have to be built into the objective curve.

(2) Cost to Administer - In determining and then enforcing class standards, society depends upon the process of a complex bureaucracy wrestling with a complex industry over a complex set of standards. Nevertheless, the standards would be stated in more precise fashion, be better understood by all parties, and there is no need to monitor production mix and compute averages. This category of standards should thus be less expensive to administer than those articulated as production weighted averages.

(3) Effectiveness of Ensuring Achievement - The extent to which achievement of the standard can be assured depends in part, of course, on how large an overall improvement objective is set. However, because the manufacturer is insulated from relying on the vagaries of the market, there is less reason why it could not achieve the standard than under production weighted averaging.

The previous section provided a general review of the advantages and disadvantages of class standards, and an evaluation of how they compare with production weighted average standards. The following provides a more detailed differentiation between the optional forms within this category. Variations under this category are:

(F) a standard stated as a uniform fuel economy improvement (i.e., 2.8 mpg for all classes).

(G) a variable fuel economy improvement standard based on the potential to improve each class.

The viability of utilizing standards expressed in this mode may also be seen from the curves of Figure 4. They show that comparable improvement in mpg can be realized for all classes without any reduction in weight. It may be seen that from figure 5 that the objective curve may be a fixed increment above the 1974 curve, as would be the case under Alternative F, or it may be tilted, as would be the case under Alternative G.

A refinement of the impact of these variation is as follows:

d. Impacts on Producers by Alternatives F and G

(1) Affords Producer Flexibility - Under Alternative G the objective curve can be adjusted to provide for maximum flexibility for producers. It is therefore less restrictive than Alternative F.

(2) Incentive for Post 1980 Improvement - There is no discernable difference between the impacts of Alternative F and G.

(3) Comparative Impact on Efficient Producers - Alternative F requires the same efficiency improvement on the part of the small models as the large. It does not recognize that some producers have promoted small, efficient models which have already upgraded the base from which the percentage is taken, nor that it may be more difficult to achieve additional improvement on the smaller models compared to the large.

Alternative G will require more substantial improvement of larger models, but will be more favorable to those which have already been upgraded. It will also impact the smaller models which have been inefficient.

e. Impact on Consumers by Alternatives F and G

(1) Increase in First Cost of Autos - Alternative F would distribute the improvement uniformly over the entire line and thus raise first costs proportionately higher for the smaller models than the larger ones. As noted above, Alternative G can be designed to place more of the burden for improvement on the larger models, where they can be made more economically resulting in lower overall cost increases.

(2) Distribution of Cost Increases - Alternative F would require the first costs to rise somewhat in all model classes, and they would be relatively higher on the small models, where the same achievement costs relatively more. Under Alternative G the standards could be set to eliminate this and balance the distribution of increases in first costs across the whole spectrum of models.

(3) Maintains Consumer Choice - Under Alternatives F and G, the standard is accommodated only by technological improvement, and any of the very poor performing models may be dropped rather than upgrading them to the standard. The chances for this appears to be comparable for both alternatives.

(4) Safety Costs - Under Alternative F there is some impetus to achieve the objective by designing for higher weight classes, where the standard is lower, and therefore safety would be higher under this standard than any other. This may or may not hold true for Alternative G, depending upon how the objective curve is tilted.

f. Impact on Administration of Standards Under Alternative F and G

(1) Reliance on Free Market - Neither Alternative F or G count upon consumer choice in any way to achieve the objective.

(2) Cost to Administer - Alternatives F and G are lower cost than any of the production weighted options because there is no need to tabulate production counts. Within these, Alternative G may be slightly more expensive because it requires an extensive engineering determination to arrive at the standard for each class.

(3) Effectiveness of Ensuring Achievement - Achiement of the standard should be assured equally under either alternative. It should be noted that in the context of achieving the overall national goal, both Alternative F and G rely upon mandated technological upgrading to achieve the goal. If the objectives are judiciously set, the only prospects for missing them lie with the change that there may be increased sales of the larger (through improved) models.

4. VEHICLE TAXATION (Alternatives H and I)

Taxation represents a less direct means of inducing fuel economy. While not a standard per se, and therefore not directly within the purview of the Act, representative forms of taxation were included in the analysis, to support deliberations that may arise as to the general practicability of standards vis a vis taxes on vehicles. Because the entire analysis is limited to implementation strategies that can be applied to new car sales, a variety of other forms of taxation, such as gasoline taxes and import taxes are excluded. Two representative types of vehicle taxation were considered: a tax imposed directly on sales of new vehicles based on their fuel efficiency, and an annual tax on vehicles sold after 1980, based on their fuel efficiency.

a. (H) Fuel Efficiency Excise Taxes

(1) Impact on Producers - A tax would be imposed directly on the sales of new vehicles based on their fuel efficiency. It would be progressive (e.g., exponentially increaseing) so that it would increasingly dissuade purchases of autos with increasingly poor fuel economy. Any comparison of what the manufacturers reaction might be under a tax alternative with their

reaction under a regulatory standard suffers from the face that manufacturers' compliance would not be mandatory under the tax, and would be only indirectly determined by the forces of market prices. Producers are thus free to accommodate the tax by maintaining status quo, partially responding or vigorously responding, depending upon how the forces become manifest in the competitive milieu and how they balance with other management objectives.

(a) Affords Producer Flexibility - There is broad flexibility as to the way in which the manufacturers can react to taxation measures. For all classes of vehicles they are free to proceed at their own pace, balancing the resulting increase in price against the technological upgrading which would forstall it. However, given the sensitivity of the market to first cost , they cannot be as indifferent to the excise tax as they might be to the labeling alternatives described above.

(b) Incentive for Post 1980 Improvement - The excise tax will provide continuing, unrelenting impetus for continued improvement beyond 1980, because any gain in performance will reduce the tax on individual models and thus lower perceived first cost.

(c) Comparative Impact on Efficient Producers - Those who are already producing the most efficient models will find themselves at an immediate price advantage. However, they cannot ignore the potential of their competitors to close the gap, and they therefore must maintain that technological development which would continue to maximize their own fuel economy.

(2) Impact on Consumers - The tax on new car sales would raise the initial price of those cars which, due to their relatively poor fuel economy, are already the ones most expensive to operate. Presumably most consumers would shift to less expensive and/or more efficient models.

(a) Increase in First Cost of Autos - Increase in first costs would depend upon the severity of the tax schedule, which in turn would depend upon the urgency of accomplishing the national fuel economy objective. Although exactly what levels of

taxation will stimulate the prerequisite shifts in consumer purchasing patterns is not precisely known, one analysis (1) indicates that the tax must be set high enough to make it economical for the manufacturer to employ that last, least cost effective technological improvement which, on margin, will put him over the improvement objective. As a result, first cost increases (which in part may include some tax) must be slightly higher than those other alternatives which would guarantee the goal.

(b) Distribution of Cost Increases - Ordinarily, the tax is directly passed on to the consumer as part of the purchase price of the car. In general, the tax would be higher for the larger heavier models and it is assumed that sales of those inefficient automobiles will decline. However, since these cars may be expected to be those on which manufacturers have the highest profit margin, there may be a tendency for the auto producers to absorb some of the tax rather than sacrifice these sales entirely, and redistribute profit burdens to accomplish other business objectives.

(c) Maintains Consumer Choice - An excise tax on fuel economy will cause manufacturers to eliminate some very poorly performing models, but the only external requirement to do so would be their rejection by consumers because the perceived price is too high.

(d) Safety Costs - The tax would exert some pressure to reduce sales of very heavy models, and increase demand for the smaller better performing models, so in general the motoring population will be in slightly lighter vehicles.

(3) Impact on Administration - From the point of view of general tax policy, utilization of an excise tax to enhance economy in fuel consumption would be inconsistent with the structure of the Federal excise system. Although it was customary at one time to use excises to control, or prevent, the production of certain products, this approach became less common as the Federal Government developed systems of direct controls on such items as foodstuffs, drugs, and the banking system. As a result,

excises of this type have gradually been phased out of the law or became obsolete even though still on the books. Further, this type of tax appears to be inconsistent with Government policy as expressed in the Excise Tax Reduction Act of 1965.

(a) Reliance on Free Market - For the most part, the tax translates poor fuel economy into higher price. The application of this alternative thus relies purely on the impact of the related price increases in the otherwise free market.

(b) Cost to Administer - The cost of administration will vary, depending upon whether the tax is applied at the dealer level or the manufacturer level. Taxes levied at the manufacturer level have the advantage of requiring supervision of a much smaller number of taxpayers than retail or user taxes. Furthermore, from both the point of view of the Government and taxpayers, the manufacturing level is preferred because manufacturers, being large economic units are accustomed to keeping records for excise tax purposes and have a staff which is better able to comply with the technicalities of law and regulations[1]. The reason usually advanced for collecting an excise tax on the sale of a product at the retail level is that it relieves the retailer of the need to finance the tax while he is holding the product in inventory.

(c) Effectiveness of Ensuring Achievement - Consideration of the effectiveness of this alternative requires an evaluation of its efficiency as a control measure. It is relatively simple to devise an excise tax that will serve to cut off entirely the use of a given product or service if there is an adequate substitute involved, an example being the tax (still in the law) of 2 cents per hundred on white phosphorous matches. But where the intent is not to entirely suppress a product but to restructure the product mix or technology so as to achieve a stated level of achievement (i.e., a 20% fuel saving), the problem

[1]At the present, most manufacturers (and some importers) of passenger vehicles already are paying excise tax on trucks and buses with a gross vehicle weight of over 10,000 pounds.

becomes much more difficult. While the Government has some knowledge of the effect of an equal ad valorem tax on all auto sales, it is impossible to forecast with any degree of assurance the reaction of the automobile market to a differential set of rates for cars having different performance characteristics. Lacking such knowledge, there is some risk that the tax could fail to achieve its purpose, or by "over-achieving" could unduly interfere with consumer choice with associated burden on producers.

Tax laws, by their very nature, do not lend themselves to quick adjustment if an error is made. It takes some time for the economic effects to become noticeable and even when they do a further lag is involved in obtaining new legislation. As a consequence, business operations may be affected in an undersired manner for some time. And there would be no assurance that a revised tax also might not miss the mark, especially since supply and demand conditions are changing all the time.

It is this type of uncertainty and probably adverse results as to the effect of excise taxes that reinforces the position espoused by many that excise taxes should not be used to affect the structure of an industry and influence consumer choice.

b. (I) Annual Vehicle Fuel Efficiency Taxes

(1) Description - An annual tax (similar to the personal property tax now imposed in some jurisdictions) would be levied on all vehicles after a selected future model year. It would be inversely related to fuel economy, and would reinforce consumers' demand for better fuel efficiency in new vehicles. Depending on how it was structured, it could be made to encourage earlier retirement of vehicles with poor fuel economy. However, this would have a regressive effect in that the poor, who frequently own old inefficient cars and often cannot afford new car prices would be the hardest hit.

(2) Impacts on Producers

(a) Affords Producer Flexibility - Producers may accommodate the tax with complete flexibility as to their pace and the way in which they seek to balance lost sales with technological improvements which will mitigate them.

(b) Incentive for Post 1980 Improvement - The incentive will continue as long as the tax remains in effect.

(c) Comparative Impact on Efficient Producers - There should be no unfavorable impact on those manufacturers already producing fuel efficient vehicles. However, as in the case of vehicle excise taxes, they will have to strive for continued improvement as their competitors attempt to close the gap.

(3) Impact on Consumers - Public reaction to annual use taxes for vehicles has been somewhat less than enthusiastic. Part of the problem is the mere mechanics of making payment. Additionally, there seems to be a different attitude toward Federal use taxes than, say, the Federal gasoline tax. This may be due to the fact that other Federal taxes on automotive products are included in the price charged by the retailer and thus, except for the tire tax, are not explicitly stated.

(a) Increase in First Cost of Autos - The increase price of vehicles will be lower than under exicse taxes or mandatory standards, and there would concomitantly be less technological improvement.

(b) Distribution of Cost Increase - The imposition of the annual tax would make the more fuel efficient models more competitive. As a result, there could be a tendency for profit margins to shift toward small economy cars, putting some additional pressure on first costs of those models.

(c) Maintains Consumer Choice - Consumer choice would be unaffected.

(d) Safety Costs - The tax would cause some shift to smaller cars. This would generate some increased safety risk, although of far less magnitude than the excise tax or the alternatives involving standards linked to production weighted averages.

(4) Impact on Administration

(a) Reliance on Free Market - This alternative relies on the free market to a greater extent than any others, except the labeling alternatives. However, it is only loosely coupled to market reaction since the tax penalty associated with purchasing an inefficient car is largely deferred to future years. It becomes of especially little importance to these customers for whom expense is no object in the purchase and maintenance of an automobile. The size of that particular consumer group is unknown, but is substantial, and has down through the years chosen to give minimal priority to lower insurance, taxes, and operating costs.

(b) Cost to Administer - When the tax on passenger cars was in effect in early 1971, there were less than 500 taxpayers. At the retail level there are reportedly 35,00 or more dealers in new cars. With well over 100 million registered motor vehicles, the number of vehicle owners overwhelms the number of producers or retailers, and the costs of administering the tax escalates commensurately.

(c) Effectiveness of Ensuring Achievement - The annual tax would be difficult to administer in light of the over 100 million registered motor vehicles on the road. The tax could be collected as part of each state's registration procedure. There are difficulties, however, in that federal taxation and state motor vehicle registration periods do not coincide, state employees would be required to become familiar with the new federal law, and arrangements would have to be worked out with each state. Another administrative problem would be that of establishing mpg figures for every car model and accessory combination on the road. All of these are time consuming and again there is little assurance that; once set, the tax would produce the desired effects.

APPENDIX C

RELATIVE ORDINAL RANKING OF ALTERNATIVES

The following describes the rationale for the ordinal ranking of the alternative implementation strategies, and their placement in Figure 6. As noted in Section 3.2.2 (a), with the exception of C_{30}, these are the results of ranking the alternatives on the basis of a 20% fuel economy improvemnt. This is the level stipulated by the Act, but happens also to be the level where the assessment is the most subjective because the 20% improvement can be accomplished in so great a variety of ways.

IMPACTS ON PRODUCERS

Affords Producer Flexibility

Alternatives A, B and I place no constraint whatever on the manufacturers. Alternative H represents a strong force which the manufacturer of non-economy models will be expected to accomodate to some degree, but each manufacturer is free to determine how and where he would compensate his fleet to keep it competitive.

Alternative C_{20} allows the most flexibility of those remaining. Although it is primarily the larger models which will be deficient, the manufacturers can accomodate the standard by improving the average through tecnological upgrading of any models in their line, or by shift in mix.

Alternative E would set an individual standard for each manufacturer, based upon his unique cost for making the next increment of improvement in fuel economy of his fleet. Once set, it would constrain some manufacturers more than others. However, the manufacturers would still be free to use any technological options or shift mix which would achieve the desired increase.

Alternative F and G do not allow the producer the option to accommodate the standard by changing sales mix. Further, they identify standards for all models classes, so that producers are limited to the choice of meeting the standard for that class, moving to new classes and meeting their standard, or dropping models. It also may be seen that they allow less flexibility because they define the standard at more points, or on a much finer grid.

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Alternative G can be designed and executed in such a way as to allow more flexibility than F. However, it should be noted that alternative F, in requiring all classes to improve by 2.8 mpg, does not present stringent difficulies, as shown by the following tabulation extracted from the material in Table 1:

	CLASS OF 1974 AUTO		
	Small	Medium	Large
1974 Average mpg	22.3	13.1	10.7
Improvement mandated by Alternative F	2.8	2.8	2.8
Resultant 1980 Average mpg	25.1	15.9	13.5
Improvement possible by Improved Engine (System 1)	25.6	15.7	13.4

Although the classes will be defined on a more refined grid, (e.g., 3,900 pound class, 4,000 pound class, 4,100 pound class,...) it is indicated from the grosser classification that additional production disruption over and above that which would be required for System 1 would b small.

Alternative C_{30} is more stringent than any of the above, and will force manufacturers to exploit most of their options, leaving little latitude of action.

Alternative D places an especially difficult, disproportionate objective on those producers which have already applied some of their technology options, with the result that they have fewer to chose from, and even less latitude of action.

Incentive for Post-1980 Improvement

Alternative H will provide impetus for continued improvement beyond 1980, because any gain in performance will reduce the tax on individual models and thus lower perceived first cost.

Alternative I will also provide continued impetus beyond 1980, for the same reason as given for alternative H above, However, this impetus will not be as strong as under alternative H.

Alternative B provides some incentive for continued upgrading to improve the manufacturer competitive position, vis a vis other models. It is stronger than the incentive available through alternative A.

Once the standard has been achieved under alternatives C, D, E, F or G, there is little incentive for continued improvement.

This may be corrected by a phased standard which has not been considered in the study.

Comparative Impact on Producers of Efficient Models

Alternatives A, B, H, and I, act on present status and do not mandate any change that discriminates between models or producers.

Alternative C_{20} places those who have been working to improve fuel efficiency in a better position to meet the standard than those who have not.

Alternative E recognizes the present accomplishment and the cost to achieve the next increment of fuel economy for all models. It is thus fair to those who have been improving the larger models as well.

Alternative G will require more substantial improvement of larger models, but will be more favorable to those which have already been upgraded. It will also impact the smaller models which have been inefficient.

Alternative C_{30} is more difficult to achieve (18.2 mpg) than alternative E or C_{20} (16.8) but will allow some of the smaller but inefficient models to go unimpacted, while at the same time impacting more harshly the bigger, although already improved models. It thus places those who have been working to improve fuel economy in a better position to meet the standard.

Alternative F requires the same efficiency improvement on the part of the small models as the large. It does not recognize that some producers have promoted the small, efficient models which have already upgraded the base from which the percentage is taken, nor that it is more difficult to achieve additional improvement on the smaller models compared to the large.

Alternative D is patently unfair to those manufacturers who are already producing in the more efficient range because their past progress in this area now becomes a penalty in the form of a higher absolute requirement.

IMPACT ON CONSUMERS

Increase in First Cost of Autos

Alternative A, B, and I, stipulate no specific action by manufacturers, so no increased first costs can be attributed to them.

Alternative E, by design, will achieve a 20% standard in the most economical way, and therefore results in the least overall increase in first cost.

Alternative G would force more of the increase on the larger models, where they can be made more economically.

Alternative F would distribute the improvement uniformly over the entire line and therefore raise first costs disproportionately higher on the small models than on the larger ones, to accomplish the same improvement as in alternative G.

Alternative C_{20} would increase first costs of larger cars (27% of the 1974 fleet) a great deal, and medium price cars somewhat (45% of the 1974 fleet). These percentages would be reduced by a shift in mix, but extensive technological upgrading would be required to meet the standard and the first costs would increase concomitantly.

Under alternative H, the tax should be set high enough to make it economical for the manufacturer to employ that last technological improvement which on margin will put him over the improvement objective. First cost increases then (which in part may include the tax) must be slightly higher than what would be the case under the other alternatives.

Alternative C_{30} would be harder to attain than any 20% standard and would therefore raise first cost the most.

Alternative D would force the most economical models to increase proportionately the most. Since accomplishing increased mpg is most difficult on the smaller cars, and easier on the larger cars, this would raise first costs higher than any other 20% standard, and probably as high as alternative C_{30}.

Distribution of Cost Increases

Under alternatives A and B, there would be little change in first costs in either direction. They are thus in the central position as to the others.

Alternative G would require technological upgrading and thus cause first costs of the bigger models to rise more, relatively, than the small economy models. It also forces upgrading of the inefficient small models, however, so the upgrading for increased efficiency and higher first costs would be distributed across the whole spectrum of models.

Alternative C_{20} would result in higher increased first costs of the bigger already more expensive models. At the same time, the need to maintain the competitive attractiveness of the smaller cars to encourage mix shifts may make smaller cars comparatively even less expensive.

Alternative C_{30} would have results similar to C_{20} but would be even more pronounced in that it will create a stronger need to adjust production mix, and sales of economy models must be kept even more attractive. There would be a tendency to shift present profit margins to bigger models, which would tend to dissuade their sales volume and also make those sales of larger cars that are possible more lucrative.

Alternative H would tax the larger, less efficient models the most, and the smaller economy models the least; so the increase in the preceived first cost could be much higher on the larger models.

Under alternative I, profit margins may be shifted slightly to the small good economy models, and therefore first costs of these may go up slightly more than under alternatives A or B.

Under alternative E, the burden for the 20% improvement will be distributed across all models in the way which minimizes overall cost to the fleet. Since more cost effective improvements can be made on larger models than smaller ones, their costs will increase slightly more. The shift mix option will tend to cause manufacturers

to keep small car prices slightly lower than that which response to alternative G would place on the small good economy models.

Alternative F would require the first costs to rise somewhat in all model classes, but they would be slightly higher on the small models, where the same achievement costs relatively more.

Under alternative D, small good economy models would suffer a disproportionate increase in the required improvement. The manufacturers would have to meet this through technological upgrading, and therefore relative price increases of small models will be higher than under any other alternative.

Maintains Consumer Choice

Alternatives A, B, and I would not cause the dropping of any model by any manufacturer, and therefore consumer choice is not impaired.

Alternative H might have some tendency to cause a manufacturer to eliminate some very poorly performing models, but there would be no external requirement for him to do so.

Alternative E would keep the increased cost most balanced and also allows for accommodation by mix shift. It could possibly cause the elimination of some models, but would be less likely to do so than the other 20% standards.

Under alternative D, there is some chance that manufacturers of some of the small, most efficient lines would have to drop some of their models. Alternative C_{20} could cause manufacturers to drop some of their poorest performing large models, but there is no reason to believe the changes for this would be any higher or lower than under alternative D. Under alternative F and G, the standard is accommodated only by technological improvement, and any of the very poor performing models may be dropped rather than upgrading them to the standard. The chances for this appear to be comparable for all four alternatives.

Under alternative C_{30}, which is the most difficult to achieve, there would be more expectation that some models will be dropped, than under any 20% standard.

Safety Costs

Under alternatives F and G, there is some impetus to achieve the objective by designing for increased wieght classes, and therefore safety would be higher under this standard than any other.

Under alternatives B and A, there is some slight impetus to more toward lighter cars.

Under alternative I, there is slightly stronger impetus to move toward lighter cars than under A or B.

Under alternative E, there are more pronounced pressures to improve fuel efficiency of all models, the smaller cars as well as the larger, so they will all get lighter, and their occupants will be less safe.

Under alternative C_{20}, there is more pressure to eliminate the very heavy models, and more emphasis on promoting the smaller models, so the driving population will be in slightly higher vehicles than under A, B, or E.

The tax under alternative H should have even more pronounced effects than alternative C_{20} in moving people to lighter cars.

Under alternative D, there is undo pressure to improve the smaller models so the light cars will be even lighter and their occupants will be even less safe. Under alternative C_{30}, a larger proportion of the population will be in lighter cars, but is difficult to discern whether or not this would make the total number of occupants at risk less safe than under alternative D.

IMPACT ON ADMINISTRATION OF THE STANDARD

Reliance on the Market

Alternative A and B both rely totally on the market, and the ability of the consumers to make their selection on the basis of better fuel economy information.

Alternative I represents a minimum form of government intrusion that does not in any way reduce the range of consumer choice, but depends upon his anticipation of paying an added tax based on

fuel economy to be translated into a heightened demand for better performing models.

Alternative H represents a more pronounced form of government intrusion that also does not reduce the range of choice but depends upon the graduated inversely related tax on fuel economy to be immediately translated into heightened demand for better performing models.

Alternative C_{20}, D, and E, represents a substantial intrusion into the market to assure that the 20% improvement goal will be realized, but still depend upon consumers selecting the sales mix that when coupled with technological improvement, will attain the objective.

Alternative C_{30} represents a more substantial intrusion into the market than C_{20}, and some models may be eliminated. It also depends upon consumers selecting a mix that contains a high proportion of good economy cars.

Alternatives F and G represent the highest form of intrusion and do not count upon consumer choice in any way to achieve the objective.

Cost to Administer

Alternative A requires some government activity, but it is limited.

Alternative B will require certification and test, as will every other alternative except A.

Alternative F and G are lower cost than any of the production weighted options because there is no need to tabulate production counts. Alternative G may be slightly more expensive because it requires an extensive engineering determination to arrive at the standards for each class.

Alternative C_{20}, C_{30}, and D, as production weighted standards, would require monitoring of production counts as well as certification and test procedures.

Alternative E would be the most expensive of the production weighted alternatives because it would require an extensive determination of the relationships between engineering changes and costs for each manufacturer to arrive at the objective unique to its production.

Alternative H would require the collection of the tax from all dealers and is therefore more expensive than any of the above.

Alternative I would require the collection of the tax from all vehicle owners annually, and therefore would be the most expensive of all.

Effectiveness of Insuring Achievement

Alternative F and G rely upon technological upgrading mandated to a specific level, to achieve the goal. The only prospects for missing it lie with the chance that there may be increased sales of the larger (though improved) models.

Alternative C_{20}, C_{30}, D, and E, all rely on the ability of the manufacturers to control their sales mix, a completely untested notion. Of these, alternative C_{30} is the most difficult and therefore the least likely of the four to be achieved. Alternative D is the most difficult of the 20% standards and therefore less likely than the other 20% standards.

Alternative H does not mandate any specific manufacturer action but is a compelling government move. The goal is less likely to have an immediate direct impact on forcing technological upgrading.

Alternative I has an effect more indirect than H, and therefore is less forceful in assuring the goal. It would be more effective than alternative B, which requires no specific action by the manufacturers to upgrade and therefore does not generate any result. Alternative B in turn is stronger than A which is totally voluntary.

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16. Abstract

This Policy Assessment Panel Report is Report Number One (1) of seven (7) panel reports prepared by special panels of a task force established under joint chairmanship of the U.S. Dept. of Transportation and the U.S. Environmental Protection Agency to conduct a study of the practicability of a 20% fuel economy improvement for new motor vehicles in the 1980 time frame. Materials developed by the various study panels were used in preparing the Report to the Congress entitled "Potential for Motor Vehicle Fuel Economy Improvement" dated 24 October 1974 (second printing 18 November 1974).

This panel report selects eight specific fuel economy improvement strategies which fall into the broad catagories of new car fuel economy labeling, government established and enforced fuel economy standards and vehicle taxation to dissuade purchases of new automobiles with poor fuel economy. The strategies are evaluated on the basis of their impact on consumers, producers and government administration. The report concludes that none of the strategies is clearly preferable over all the others. Each has its strength and weakness.

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